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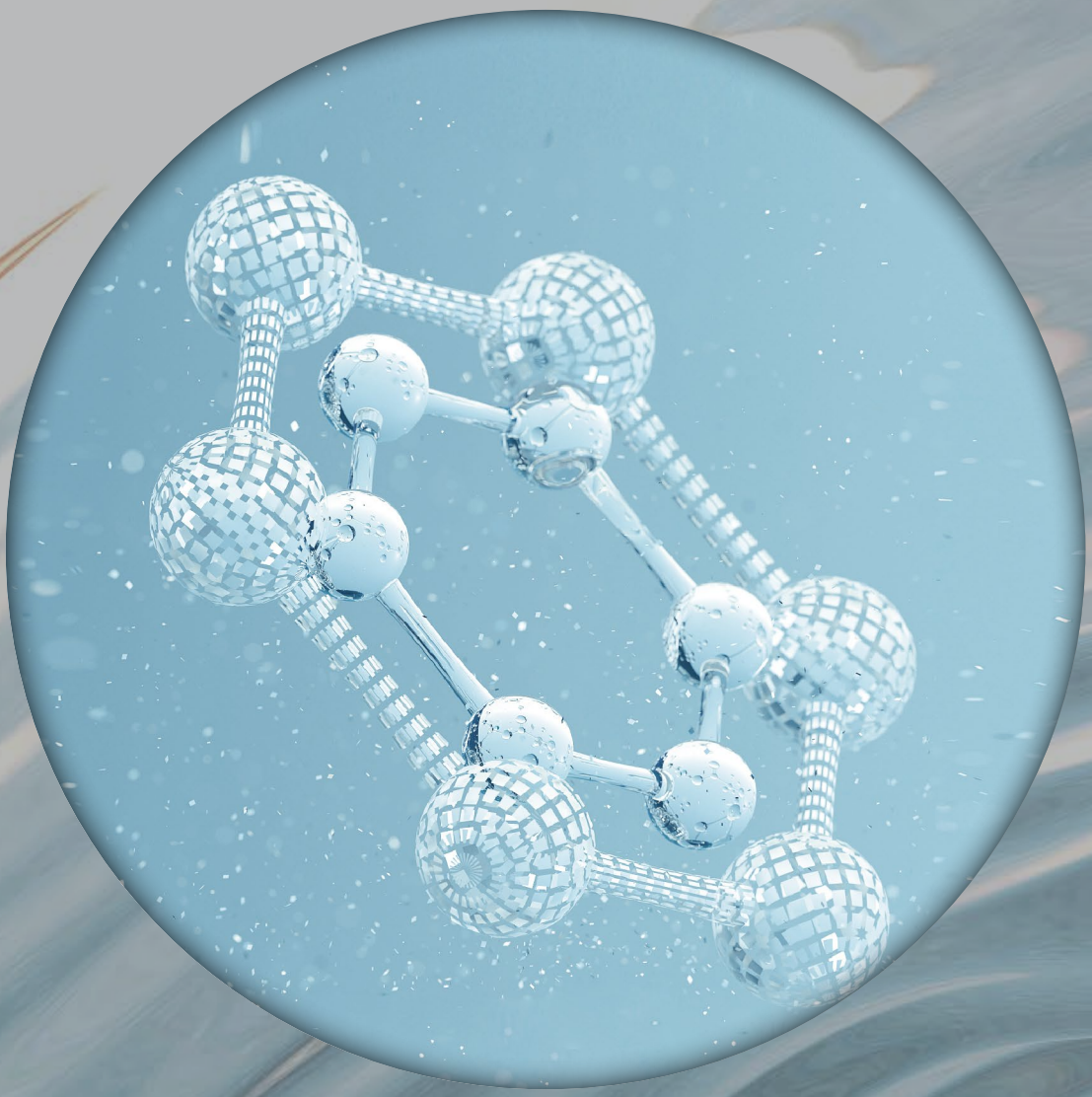
Jul.2022 & Aug.2022



SYNTHETIC BIOLOGY

合成生物学

天府生命科技园
Tianfu Life Science Park

合成生物学作为一门前沿交叉学科，掀起了继DNA双螺旋结构发现和基因组测序技术诞生之后的"第三次生物科学革命"，极具前沿性和颠覆性。

As a frontier interdisciplinary subject, synthetic biology has set off the "third revolution in bioscience" following the discovery of DNA double helix structure and the birth of genome sequencing technology, which is very pioneering and subversive.

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成都高投生物医药园区管理有限公司 编
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内部资料 仅供参考

BIO Collaborate

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INDEX.

01 编者语 Editor's Note

EDITOR'S NOTE

合成生物学作为一门前沿交叉学科，掀起了继DNA双螺旋结构发现和基因组测序技术诞生之后的"第三次生物科学革命"，极具前沿性和颠覆性。随着近年来合成生物学研究的不断突破和先进工业生物技术的快速发展，生物制造正在重新定义绿色产品和生产方式。尤其自2021年以来，海内外合成生物学企业上市和资本市场的表现都体现出该领域未来的发展潜力巨大。

As a frontier interdisciplinary subject, synthetic biology has set off the "third revolution in bioscience" following the discovery of DNA double helix structure and the birth of genome sequencing technology, which is very pioneering and subversive. With the unremitting breakthroughs in synthetic biology study and the rapid development of advanced industrial biotechnology in recent years, bio-manufacturing is redefining the green products and production methods. Especially since 2021, the listing of synthetic biology companies at home and abroad and their performance in the capital market have proved the huge potential of future development of this sector.

从产业角度来看，生物合成属于制造业中的新兴轻工业。我国制造业具有良好的产业基础和配套的工业体系，下游工业生产方面优势显著，这是我国发展合成生物产业的优势所在。而劣势在于，我国正处于合成生物学蓬勃发展的早期，商业模式和技术模式还处于形成初期，需上中下游链条高度配合，因此产业和市场的成熟还需一定发展时间。但随着技术和人才的不断积累，在资本和政策的助推下，合成生物产业的快速发展势不可挡，必将有越来越多的合成生物企业涌现，在攻克未来医药与健康、人口与粮食、资源与环境、能源与材料等领域的重大难关时发挥关键作用，值得期待。

From an industrial point of view, biosynthesis is an emerging light segment in manufacturing. China's manufacturing industry boasts a favorable industrial foundation and supporting industrial system, and marked advantages in industrial production downstream, thus laying a solid foundation for the development of synthetic biology. Its disadvantage lies in the fact that China is still at an infancy stage of development for the synthetic biology sector, when the business and technology models are yet to be formed and a high coordination is required for enterprises at the upstream, mid-stream and downstream of the industrial chain. Thus, it costs more time for the industry and market to develop into maturity. However, with the continuous accumulation of technology and expertise and the boosting of capital and policies, the synthetic biology industry is bound to embrace a rapid development, and increasingly more synthetic biology companies will emerge to play a key role in overcoming major challenges in the fields of medicine and health, population and food, resources and environment, and energy and materials in the future. We're looking forward to their performance then.

02 新闻速递 News Feeds

LIVE

园区新闻

PARK NEWS

百利药业 BAILI PHARMACEUTICAL

好消息！中国首个儿童专用ACEI口服溶液获批上市百利儿童药家族再添新成员

Good News! The First ACEI Oral Solution for Children in China Approved to Be Listed & A New Pediatric Drug of Baili

6月28日安贝忻®马来酸依那普利口服溶液获批上市，成为中国首个专用于儿童的ACEI口服溶液，为各年龄段高血压，心力衰竭以及肾脏疾病的患儿带来更加精准、安全、便捷的药物治疗选择。

On June 28, Anbeixin® Enalapril Maleate Capsules Oral Solution was approved to be put on the market. It was the first ACEI oral solution for children in China, and it is a drug treatment option that is more accurate, safe and convenient for child patients of all ages with hypertension, heart failure and kidney disease.

据悉，百利药业一直坚守儿科领域，除安贝忻®以外，儿童药研发管线上还有7个获得国家重大新药创制专项的产品。处在上市前阶段涉及小儿重症、围术期、小儿神经等多个治疗领域，聚焦血液肿瘤的创新药项目，也将有望在今年下半年进入儿童临床试验阶段。

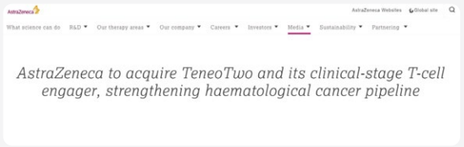
According to the report, Baili Pharmaceutical has always made great efforts in pediatrics, and in addition to Anbeixin®, it also has 7 national major innovative drug development special products in such therapeutic fields as pediatric severe disease, perioperative period, pediatric nerve, etc. on the pediatric drug development lines in the pre-market stage. A new drug project targeted at hematologic tumors is also expected to enter the clinical trial of children later this year.

阿斯利康12.65亿美元收购药企加码布局血液肿瘤业务

AstraZeneca Acquires Pharmaceutical Company for USD 1.265 Billion to Expand the Business in Hematologic Tumor

7月5日，阿斯利康通过全球官网宣布将以12.65亿美元的价格收购 TeneoTwo公司。这份协议包括处于一期临床阶段的药物TNB-486，目前正在评估该药对复发和难治性B细胞非霍奇金淋巴瘤的效果。

On July 5, AstraZeneca announced on its global website that it would acquire TeneoTwo for USD1.265 billion. The protocol includes the drug TNB-486 at the Phase I clinical stage, and the drug is currently being evaluated for effect on relapsed and refractory B-cell non-Hodgkin's lymphoma.



丰富血液瘤管线
Strengthening the Haematological Tumor Pipeline

通过收购TeneoTwo，阿斯利康将获得其I期临床阶段的CD19/CD3T细胞接合剂TNB-486，TNB-486是一款靶向CD19/CD3的TCE，属于双特异性T细胞衔接器(BiTE）。

Through the acquisition, AstraZeneca will acquire TeneoTwo's CD19/CD3 T-cell engager TNB-486 at the Phase I clinical stage. TNB-486 is a bi-specific T-cell engager (BiTE) and a TCE targeting CD19/CD3.

研究显示，TNB-486通过与CD19（一种在B细胞上表达的抗原）和T细胞上的CD3受体结合，激活T细胞并将其募集到表达CD19的肿瘤中，引发免疫反应。

A study showed that TNB-486 initiates an immune response by binding CD19 (an antigen expressed on B cells) and CD3 receptors on T cells, which activates T cells and recruits them to CD19-expressing tumors.

在体内模型中，TNB-486在多个模型，即人外周血单个核细胞存在的情况下，清除免疫缺陷小鼠CD19+肿瘤细胞；此外，TNB-486在小鼠或食蟹猴体内的PK与传统抗体相似。

In vivo models, TNB-486 can clear CD19+ tumor cells in immunodeficient mice in the presence of human peripheral blood mononuclear cells in multiple models. Moreover, the PK of TNB-486 in mice or cynomolgus monkeys is similar to that of conventional antibodies.

目前，TNB-486正用于B细胞血液系统恶性肿瘤，包括弥漫性大B细胞淋巴瘤和滤泡性淋巴瘤的适应症开发。

Currently, TNB-486 is being developed for indications in B-cell hematological malignancies, including diffuse large B-cell lymphoma and follicular lymphoma.

阿斯利康中国肿瘤事业部总经理陈康伟表示，"阿斯利康自1993年进入中国以来，专注中国患者需求最迫切的治疗领域，已经将近40种创新药物带给中国患者，其中包括肺癌、前列腺癌、卵巢癌和乳腺癌等领域创新药。公司也正在向血液肿瘤、消化道肿瘤等重要的肿瘤领域发展，持续开拓抗体偶联药物、新一代BTK抑制剂以及免疫治疗等创新疗法实现更多癌种广覆盖。

"Since AstraZeneca entered China in 1993, AstraZeneca has brought nearly 40 innovative drugs to Chinese patients, focusing on the most pressing therapeutic fields, including lung, prostate, ovarian and breast cancer. The company is also expanding into major oncology areas such as hematologic and digestive tract tumors, and continues to explore drugs in innovative therapies, such as antibody-coupled drugs, new-generation BTK inhibitors, and immunotherapy to treat more cancer types." said Chen Kangwei, General Manager of AstraZeneca Oncology China.

阿斯利康中国西部总部落户成都前沿医学中心
AstraZeneca China West Headquarters in Chengdu Advanced Medical Science Center

据悉，预计到2025年，阿斯利康可在中国上市5个肿瘤新药，涉及乳腺癌、肺癌、胃癌、淋巴癌等高发肿瘤领域。

It is reported that AstraZeneca is expected to put 5 innovative cancer drugs to the market in China by 2025, involving breast cancer, lung cancer, gastric cancer, lymphatic cancer and other high-incidence tumor fields.

全球新！海博为药业首个1类透脑新药在国内正式申报临床研究

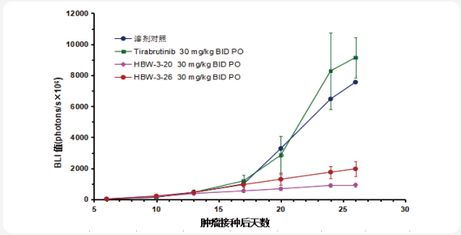
Brand New! Hyperway Pharmaceuticals Officially Applies for Clinical Study of Class 1 Blood-brain Barrier Penetrating (BBBP) Innovative Drug

7月25日，成都海博为药业有限公司（简称"海博为药业"）自主研发的强透脑、抗耐药、可逆三代BTK抑制剂HBW-3-20已正式申报临床研究。该项目是继公司首个创新药HBW-3220胶囊获得临床默示许可之后的又一个临床研究项目申请，标志着海博为药业在小分子靶向创新药研究方面实现了新跨越。HBW-3-20是全球首个具有强透脑性的三代BTK（布鲁顿酪氨酸激酶）抑制剂，拟用于B细胞非霍奇金淋巴瘤，主要开发适应症为原发性/继发性中枢神经系统淋巴瘤（PCNSL/SCNSL）或可能累及中枢神经系统的弥漫大B细胞淋巴瘤（DLBCL）。

On July 25, Chengdu Hyperway Pharmaceuticals Co., Ltd. (hereinafter referred to as "Hyperway Pharmaceuticals") officially applied for a clinical study of HBW-3-20, the self-developed reversible third-generation BTK inhibitor with strong blood-brain barrier penetration and antimicrobial resistance. This application for the clinical study project is second after the company's first innovative drug HBW-3220 capsule was approved through clinical implication, marking a new leap of Hyperway Pharmaceuticals in small molecule targeted innovative drug research. HBW 3-20 is the world's first third-generation inhibitor of BTK (Bruton's tyrosine kinase) with strong blood-brain barrier penetration. It is mainly developed for indications of primary/secondary central nervous system lymphoma (PCNSL/SCNSL) or diffuse large B-cell lymphoma (DLBCL) with possible central nervous system involvement.

原发性中枢神经系统淋巴瘤(PCNSL)是一种起源于脑、软组织、脊髓或眼的原发性结外非霍奇金淋巴瘤亚型，90%以上的组织学病理类型为弥漫大B细胞淋巴瘤(DLBCL)。该病侵袭性强、进展快，与其他类型淋巴瘤相比，患者生存期短、预后差。流行病学研究显示，近年来，PCNSL的发病率呈上升趋势，约占所有脑部肿瘤的4%，占结外淋巴瘤的4%-6%，防治形势严峻，靶向药物的市场需求极为旺盛。布鲁顿酪氨酸激酶(BTK)是B细胞相关肿瘤的基本靶点，BTK抑制剂在淋巴瘤及白血病治疗方面已经取得了巨大成功，但是PCNSL/SCNSL发病部位独特，存在血脑屏障，大约95%以上的药物无法达到病变的脑部组织，大大增加了治疗难度。

Primary central nervous system lymphoma (PCNSL) is a primary extranodal non-Hodgkin lymphoma subtype originating from the brain, soft tissue, spinal cord or eyes. More than 90% of the histological and pathological types are diffuse large B-cell lymphoma (DLBCL). Compared with other types of lymphoma, the disease is highly invasive and progressing fast. Patients with this disease have a short survival time and poor prognosis. Epidemiological studies show that in recent years, the incidence of PCNSL has been on the rise, accounting for about 4% of all the patients with brain tumors and 4%-6% of patients with extranodal lymphoma. The prevention and treatment confront a severe situation, and the market has a large demand for targeted drugs. Bruton's tyrosine kinase (BTK) is a fundamental target of B cell-associated tumors, and BTK inhibitors have achieved great success in the treatment of lymphoma and leukemia. However, the pathogenic site of PCNSL/SCNSL is unique since there is a blood-brain barrier, and about 95% of drugs cannot reach the diseased brain tissue, which greatly increases the difficulty of treatment.



HBW-3-20是海博为药业透脑创新药物开发平台开发的全球首个强透脑、抗耐药可逆的三代BTK抑制剂，与第一个被批准用于治疗复发或难治性PCNSL的一代不可逆BTK抑制剂Tirabrutinib（日本小野制药开发）相比，在透脑性（大鼠透脑率：>60% VS ~10%）、有效性等关键成药性方面都有着突出的优势，且能克服Tirabrutinib第一代BTK抑制剂由于C481S突变产生的耐药性问题，开发价值巨大。

HBW-3-20 is the world's first third-generation reversible BTK inhibitor with strong blood-brain barrier penetration and anti-drug resistance developed by the BBBP innovative drug development platform of Hyperway Pharmaceuticals. Compare this with Tirabrutinib (Ono Pharmaceuticals, Japan), the first-generation irreversible BTK inhibitor approved for the treatment of relapsed or refractory PCNSL, it has outstanding advantages in key drug properties, including the blood-brain barrier penetration (BBBP rate in rats: →60% VS ~10%) and efficacy, and it can overcome the problem of drug resistance of Tirabrutinib first-generation BTK inhibitor caused by C481S mutation, with a high development value.

好医生康复新品牌 荣获金远奖品牌类奖

Kangfuxin of Good Doctor Has Won the Golden Vision Awards and the Best Brand Award Successively

7月8日，经过200多位专家客观公正的对"好医生爱胃爱健康系列"公益活动进行评审，好医生康复新品牌从2000多份申报资料中脱颖而出获得第十四届广告主金远奖"社会化营销类金奖"。这是好医生集团在营销传播领域首次获得的专业奖项，也是中医药企业品牌营销首次荣获的专业奖项。

On July 8, after the objective and fair review of more than 200 experts on the public welfare activity, "Pursuit to Healthy Stomach" held by Good Doctor, the brand stood out among over 2,000 competitors and won the "Gold Award in Social Marketing" in the 14th Advertiser & Golden Vision Awards. This is the first professional award for Good Doctor Group in marketing propagation, and also the first professional award for brand marketing of traditional Chinese medicine enterprises.

"爱胃爱健康"系列公益活动深入人心

"Pursuit to Healthy Stomach" Enjoys Popular Support

金远奖是国内营销传播类领域的专业奖项，至今已走过十四个年头。该奖项秉承戛纳、莫比、纽约、克里奥、伦敦等全球五大广告奖先进理念，融入艾菲奖的实效诉求，与国际全面接轨的同时，又契合本土实际。

As a professional award in the field of marketing propagation in China, the Golden Vision Awards has come along for 14 years. The award inherits the advanced concept of the Top 5 global advertising awards, namely, Cannes Lions Advertising Campaign, Mobius Advertising Awards, New York Festivals Advertising Awards, Clio Awards and London International Advertising Awards, and integrates the pragmatic appeal of Effie Awards. It not only fits the international situation but also the local reality.

天府生命科技园企业世联康健荣登全国人工智能医疗器械创新任务榜

A Company in Tianfu Life Science Park Listed in the Enterprises for National AI Medical Device Innovation Tasks

8月15日，由工业和信息化部、国家药品监督管理局共同组织开展的国家级"人工智能医疗器械创新任务揭榜入围单位"正式揭晓。天府生命科技园企业成都世联康健生物科技有限公司牵头的"口腔颌面部手术主动导航定位系统"，在全国千余项申报项目中脱颖而出，成功入围"智能辅助治疗产品"重点攻关方向的全国十家揭榜单位，也是唯一一家入围本次人工智能医疗器械创新任务揭榜的成都企业。

On August 15, "Shortlisted Enterprises for National AI Medical Device Innovation Task" jointly organized by the Ministry of Industry and Information Technology and the National Medical Products Administration was officially unveiled. "Active Navigation and Positioning System for Oral and Maxillofacial Surgery" led by Chengdu Shilian Kangjian Biotechnology Co., Ltd. in Tianfu Life Science Park stood out among more than one thousand applied projects nationwide. The company has also been listed among the ten national enterprises for the key research project, "intelligent adjuvant therapy products", and it was the only enterprise to be listed in the "List of Enterprises for National AI Medical Device Innovation Tasks" in Chengdu.

此外，世联康健组建的"四川省精准手术治疗设备工程研究中心"，也进入四川省发展和改革委员会印发的《四川省工程研究中心(赛马制)复赛入围名单》。

In addition, the "Sichuan Engineering Research Center for Precision Surgical Treatment Equipment" established by Chengdu Shilian Kangjian Biotechnology Co., Ltd. has also entered the Shortlist of Sichuan Engineering Research Centers (Horse-racing Mechanism) for the Semi-final Competition issued by the Sichuan Provincial Development and Reform Commission.

人工智能医疗器械创新任务揭榜入围单位

方向二：智能辅助治疗产品			
1	揭榜单位	宽光谱超分辨智能内窥镜分子成像系统	珠海市迪谱医疗科技有限公司
2	揭榜单位	骨科手术智能规划与操作系统	北京天智航医疗科技股份有限公司
3	揭榜单位	肺部手术导航系统	苏州朗开医疗技术有限公司
4	揭榜单位	智能全骨科手术辅助机器人系统的研发与应用	骨圣元化机器人（深圳）有限公司
5	揭榜单位	智慧化放射治疗计划系统软件	中科超精（南京）科技有限公司
6	揭榜单位	高频疑脉冲脑胶质瘤治疗系统	苏州博思得电气有限公司
7	揭榜单位	介入穿刺消融治疗肿瘤的智能机器人研发	华中科技大学同济医学院附属协和医院
8	揭榜单位	人工智能微创血管介入手术机器人系统	易度河北机器人科技有限公司
9	揭榜单位	口腔颌面部手术主动导航定位系统	成都世联康健生物科技有限公司
10	揭榜单位	脊柱超声手术器械导航控制系统	北京铸正机器人有限公司

百利药业冲击科创板 创新药研发显实力

Baili Pharmaceutical Strives for Science and Technology Innovation Board and R&D of Innovative Drug Shows Strength

8月1日，四川百利药业股份有限公司披露招股说明书（申报稿）。安信证券为其保荐机构，IPO拟募资14.22亿元，分别用于抗体药物产业化建设、抗体药物临床研究、肿瘤治疗领域创新抗体类药物研发和新冠治疗领域创新抗体类药物研发项目。

On August 1, Sichuan Baili Pharmaceutical Co., Ltd. disclosed its prospectus (draft of reporting). With Essence Securities as its sponsor, it planned to raise a fund of RMB 1.422 billion in IPO for antibody drug industrialization construction, clinical study of antibody drugs, and R&D of innovative antibody drugs in the field of cancer therapy and COVID-19 treatment.

目前，百利药业主要销售品种有丙泊酚中/长链脂肪乳注射液、丙泊酚乳状注射液、盐酸右美托咪定注射液、中/长链脂肪乳注射液等多种化学仿制药，以及黄芪颗粒、柴黄颗粒等中成药制剂。

At present, the major varieties of Baili Pharmaceutical in sales include propofol medium/long chain fat emulsion injection, propofol emulsion injection, dexmedetomidine hydrochloride injection, medium/long chain fat emulsion injection and other chemical generic drugs, as well as Chinese patent medicine preparations such as Huangqi Granules and Chaihuang Granules.

百利药业从2011年就开始布局全球创新生物药领域。百利药业运用化药制剂与中成药制剂业务所产生的现金流支持反哺于公司创新生物药的研发。此次百利药业科创板IPO拟募资14.22亿元，也将全部用于抗体药物研发。截至目前，百利药业拥有全球权益的核心创新生物药在研品种16个，其中7个已进入临床研究阶段，9个候选生物药已进入临床前药理、毒理等研究阶段。药物涵盖双/多特异性抗体、ADC药物、融合蛋白等不同类型。

Baili Pharmaceutical has started to arrange its innovative biological medicine field in the world since 2011. The company uses the cash flow generated by the business of pharmaceutical preparations and Chinese patent medicine preparations to support the R&D of innovative biological drugs in the company. This time, Baili Pharmaceutical has raised RMB 1.422 billion in IPO on the Science and Technology Innovation Board, all of which will be used for the R&D of antibody drugs. Up to now, Baili Pharmaceutical has 16 core innovative biological drugs under development with global rights and interests, of which 7 have entered the clinical study stage, and 9 candidate biological drugs have entered the preclinical study research for pharmacology, toxicology and so on. The drugs are of different types, such as bi-/poly-specific antibodies, ADC drugs and fusion proteins.

INDUSTRIAL NEWS

● LIVE

行业新闻

惠利生物完成近3亿元A轮融资

Huili Bio Secures Series A Funding of Nearly RMB 300 million

7月4日，新一代合成生物学酶计算设计平台惠利生物近日宣布完成近3亿元A轮融资，由君联资本、博远资本联合领投，千骥资本、云启资本、众为资本跟投，泰合资本担任独家财务顾问。本轮融资将用于加速规模化生产设施的建设运营、新产品管线的研发落地以及人才团队扩充。

Huili Biotechnology

It is reported on July 4 that Jiangsu Huili Biotechnology Co., Ltd., a computational design platform of next-generation synthetic biology enzymes, recently announced the completion of a Series A financing round of nearly RMB 300 million. The investment was jointly led by Legend Capital and BioTrack Capital, followed by Cenova Capital, Yunqi Partners and ZWC Partners, with Taihecap acting as its exclusive financial advisor. The funding raised will be used to accelerate the construction and operation of large-scale production facilities, the R & D and implementation of new product pipelines and the expansion of the professional team.

惠利生物创立于2018年，其核心技术平台——酶计算设计平台，是国内首个实现酶全场景设计的计算平台，对酶"序列-结构-功能"进行更深层次的规律解析和挖掘设计，大幅优化筛选效率，高效实现酶功能改造，变革性地推动绿色生物制造的发展。

Founded in 2018, Huili Bio's core technology platform, enzyme calculation design, is the first computational platform in China to have realized full-scenario design of enzymes, provided deeper law analysis, mining and design of enzyme "sequence-structure-function", significantly optimized screening efficiency, efficiently modified enzyme functions, and transformatively driven green (environmental-friendly) biomanufacturing.

首届合成生物学竞赛成功举办

The First SynBio Challenges and SynBio Hive Successfully Held

2022年7月9-10日，首届合成生物学竞赛(创新赛和创业赛)于深圳光明区深圳理工大学(筹)明珠校区成功举办。创新赛由中国生物工程学会合成生物学分会主办，创业赛由DeepTech主办，共同由深圳市合成生物学协会等单位协办。这是我国首次举办面向高校学生的合成生物学竞赛，旨在为青年学生提供交流学习、创新、创智、创造的平台，为合成生物学、生命科学、交叉学科培养后备生力军。

邓子新院士在创业赛上致辞
Academician Deng Zixin addresses the SynBio Hive

The first SynBio Challenges and SynBio Hive were successfully held on July 9-10, 2022 at the Mingzhu campus of Shenzhen Institute of Advanced Technology (tentative name) in Guangming District, Shenzhen. The SynBio Challenges contest was organized by the synthetic biology branch of the Chinese Society of Biotechnology, and the SynBio Hive contest was hosted by DeepTech and co-organized by Shenzhen Synthetic Biology Association and others. It is the first time that synthetic biology competitions for college and university students have been held in China, aiming to offer an exchange and learning platform for them to make innovations, create ideas, and develop creativity, and to train a reserve force for synthetic biology, life science and interdisciplinary disciplines.

SYNBIO HIVE

创新赛现场合影
Group photo at the SynBio Challenges

活动吸引了来自全国21所高校共27支队伍参赛，线上线下超220万人次观赛，中国科学院院士、美国医学与生物工程院院士、欧洲科学院院士、乌克兰国家科学院院士等港澳及海内外一流高校机构的近30位顶尖学者坐镇竞赛现场。此次竞赛不仅是青年学生间开展的头脑风暴与思想碰撞，也是合成生物领域"开路者"与"践行者"对于科学家精神与创新精神的接力现场，是合成生物学向新一代青年传承的盛会。

The event has attracted a total of 27 teams from 21 colleges and universities across the country, and has been watched by over 2,200,000 people online and offline. Nearly 30 top-notch academics from Hong Kong SAR, Macao SAR and first-class schools and institutions at home and abroad are in attendance, including academicians of the Chinese Academy of Sciences, the American Institute for Medical and Biological Engineering, the Academia Europaea (Academy of Europe), and the National Academy of Science of Ukraine. The event is not only brainstorming and collision of ideas among college and university students, but also a relay of scientist and innovation spirits among the "pathfinders" and "practitioners" in the field of synthetic biology, and a grand meeting for the transmission of synthetic biology to the new generation of young people.

国内首个合成生物来源的中药活性成分制剂获美国FDA许可开展新药临床试验

China's First Synthetic Bio-sourced Active Ingredient Formulation of Traditional Chinese Medicine Licensed by the United States' FDA for Clinical Trials of New Drugs

7月29日，中国中医科学院中药资源中心黄璐琦院士的分子生药学团队与中科院天津工业生物技术研究所、四川弘合生物科技有限公司合作开发的KH617新型制剂，已获美国食品药品管理局许可开展新药临床试验。中国临床试验申请也已获国家药品监督管理局药品审评中心同意受理，有望成为国内第一个合成生物学来源的植物天然产物新药。该制剂以合成生物学方法构建的中药活性成分工程菌生产的高纯度原料开发成新型制剂，拟用于治疗晚期实体瘤和复发胶质母细胞瘤。制剂研究联合四川大学、药效确认联合哈佛大学麻省总医院团队共同完成。

On July 29, a new formulation KH617, developed by Academician Huang Luqi's molecular biopharmacology team at the China Academy of Chinese Medicine Sciences Resource Center in collaboration with the Tianjin Institute of Industrial Biotechnology, Chinese Academy of Sciences and Sichuan Honghe Biotechnology Company Limited, was licensed by the US Food and Drug Administration for clinical trials of new drugs. The domestic clinical trial application of the formulation has also been accepted by the Center for Drug Evaluation, NMPA, which is expected to be the first new plant-based natural drug of synthetic biological origin in China. The formulation, developed as a novel formulation using high-purity raw materials produced from an engineered Chinese medicine active ingredient constructed by synthetic biology methods, is intended for the treatment of advanced solid tumors and recurrent glioblastoma. The formulation study was done in collaboration with Sichuan University, and pharmacodynamic confirmation was made in collaboration with the team from the Massachusetts General Hospital.

GINKGO BIOWORKS | METABIOTA®

合成生物平台Ginkgo收购流行病学数据及基础设施继续拓展生物安全业务收入

Synthetic Biology Platform Ginkgo Acquires Epidemiological Data and Infrastructure Continued Expansion of Biosecurity Business Revenues

8月19日，合成生物平台Ginkgo宣布收购Baktus子公司Metabiota的部分流行病学数据基础设施资产并且整合其数据专家团队。Ginkgo将拥有Metabiota专有的数据集、建模和分析工具，以及能够跟踪大数据、建模分析和预测流行病及相关风险和影响的软件平台，这些数据和软件平台可以帮助政府和其他合作伙伴了解和模拟病原体的风险和破坏性影响，以提高对流行病的了解和抵御能力。

On August 19, synthetic biology platform Ginkgo announced the acquisition of partial epidemiological data infrastructure assets of Baktus subsidiary Metabiota and the integration of Metabiota's data experts team. Ginkgo will own Metabiota's proprietary data sets, modeling and analysis tools, and software platforms that can track big data, do modeling analysis and predict epidemics and associated risks and impacts. These data and platforms can help governments and other partners understand and simulate the risks and devastating impacts of pathogens to improve the understanding of and resilience to epidemics.

Ginkgo还希望将Metabiota正在进行的几个流行病学分析项目和数据专家团队整合到其生物安全和公共卫生计划"Concentric by Ginkgo"中。Concentric by Ginkgo平台目前由全国性实验室和运营网络提供支持，在美国数千个地点提供全面的COVID-19监测计划和服务，包括学校、机场和其他聚集环境。在此基础上，目标是建立可持续的全球生物安全基础设施，以帮助检测、减轻和应对各种生物威胁，Ginkgo预计此次交易将成为开发该基础设施的关键里程碑。

Ginkgo also hopes to integrate several of Metabiota's ongoing epidemiological analysis projects and data experts team into its biosecurity and public health program 'Concentric by Ginkgo'. The Concentric by Ginkgo platform, currently supported by nationwide laboratories and operation networks, provides comprehensive COVID-19 surveillance programs and services in thousands of locations across the United States, including schools, airports and other crowded places. Building on this foundation, the goal is to create sustainable global biosecurity infrastructure to help detect, mitigate and respond to a wide range of biological threats, and Ginkgo expects this transaction to be a key milestone in developing that infrastructure.

03 创新前行
Advance with Innovation

成都高投生物医药园区管理有限公司为入驻天府生命科技园和成都前沿医学中心的企业提供覆盖企业产品和成长全生命周期的一站式科技服务。

企业产品全生命周期专业服务： 提供从研发到生产，再到销售的3大类14项专业服务；

企业成长全生命周期专业服务： 提供创业指导、科技金融、人才服务等19大类40项共性服务；

CDHT Investment Group Biomedicine Industrial Park Management Co. Ltd provides one-stop science & technology service system for the companies settled in Tianfu Life Science Park and Chengdu Frontier Medical Center, covering the whole life cycle of their products and growth.

Professional services for the life cycle of enterprise products: provide 14 professional services in 3 categories from R&D and production to sales;

Professional services for the life cycle of enterprise growth: provide 40 common services in 19 categories, including entrepreneurial guidance, techfin and talent services;

入园前 Before entering the park

- 创业指导 Entrepreneurial guidance
- 项目评审 Project review

企业成长全生命周期专业服务 Professional services for the life cycle of enterprise growth

企业产品全生命周期专业服务 Professional services for the life cycle of enterprise products

研发 R&D — ❶ CRO服务 CRO Service

1. 化合物(小分子)筛选 Compound (micromolecule) screening
2. 抗体药物筛选 Antibody drug screening
3. 天然药物筛选 Natural medicine screening
4. 新药发现 New drug discovery
5. 药物合成、分析、质量研究 Pharmaceutical synthesis, analysis, and quality research
6. 药效学评价 Pharmacodynamic evaluation
7. 药物安全性评价 Drug safety evaluation
8. 药物临床试验 Drug clinical trials
9. 中试生产 Pilot scale production
10. 其他：第三方检测、干细胞存储及应用 Others: third-party testing, stem cell storage and application

入园时 When entering the park

- 工商注册 Business registration
- 环评办理 Environmental impact assessment work
- 消防办理 Fire safety formality
- 装修许可办理 Decoration permit work
- 实验室规划装修 Lab planning and decoration

入园后 After entering the park

- 科技金融 Science technology and finance
- 知识产权 Intellectual property
- 品牌推广 Branding
- 安全环保 Safety and environmental protection
- 项目申报 Project application
- 物业服务 Property services
- 园区配套 Park amenities
- 公共技术平台 Public technology platform
- 人才服务 Talent services
- 科技咨询(财税、法律) Sci-tech consulting (financial taxation, legal)
- 设施设备 Facility and equipment
- 党建纪检 Party building and discipline inspection

生产 Production — ❷ CMO/CDMO服务 CMO/CDMO Services

1. 化学药委托生产 OEM on chemical drugs
2. 生物制剂委托生产 OEM on biological agents

销售 Sales — ❸ CRO服务 CRO Service

1. 药物销售 Sales of drugs
2. 器械销售 Apparatus sales

04 行业洞察
Industry Insight

合成生物学
Industrial Insights - Synthetic Biology

01 合成生物学概述
Overview of Synthetic Biology

1.1 概念
1.1 Concept

20世纪90年代，人类基因组计划的启动与系统生物学的兴起，开启了合成生物学的发展历程。其实质是在工程学思想指导下，按照特定目标设计、改造乃至重新合成生物体系，推动生物学从模块化、定量化、标准化、通用性等角度系统地形成工程化发展。

In the 1990s, the initiation of the Human Genome Project and the rise of systems biology engendered the development of synthetic biology. Under the guidance of engineering thinking, this subject is in essence intended to design, retrofit and even re-synthesize the biological system against specific goals, thus promoting the systematic realization of engineering development of biology from the modularization, quantification, standardization, and versatility perspectives.

自发源以来，合成生物学的演进大致可分为四个阶段：
Since its origin, the evolution of synthetic biology has undergone roughly four stages:

第一阶段（2005年以前）：
以基因线路在代谢工程领域的应用为代表，这一时期的典型成果是青蒿素前体在大肠杆菌中的合成；

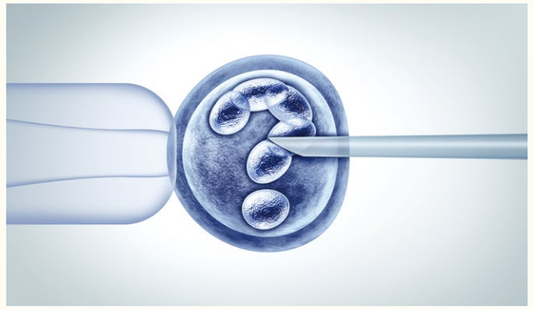
Stage I (before 2005): represented by the application of gene circuits in the metabolic engineering field, with the synthesis of artemisinin precursors in Escherichia coli as the typical achievement;

第二阶段（2005-2011年）：基础研究快速发展，年度的专利申请量较之前并未有显著增加，合成生物学研究开发总体上处于工程化理念日渐深入，平台技术得到重视，工程方法和工具不断积淀的阶段，体现出"工程生物学"的早期发展特点；

Stage II (2005-2011): rapid development of basic research, no significant increase in the annual number of patent applications compared with before, the engineering concept for synthetic biological R&D deepened, the platform technology underlined, and the engineering methods and tools accumulated, showing characteristics of early development of "engineering biology";

第三阶段（2011-2015年）：基因组编辑的效率大幅提升，合成生物学技术开发和应用不断拓展，其应用领域从生物基化学品、生物能源扩展至疾病诊断、药物和疫苗开发、作物育种、环境监测等诸多领域；

Stage III (2011-2015): great improvement in the efficiency of genome editing, constant expansion of the development and application of synthetic biology technologies, and expansion of application from bio-based chemicals and bio-energy to disease diagnosis, drug and vaccine development, crop breeding, and environmental monitoring;



第四阶段（2015年以后）：合成生物学的"设计—构建—测试"(Design-Build-Test，DBT)循环扩展至"设计—构建—测试—学习"(Design-Build-Test-Learn，DBTL)，"半导体合成生物学"(Semiconductor Synthetic Biology)、"工程生物学"(Engineering Biology)等理念或学科的提出，生物技术(BT)与信息技术(IT)融合发展的特点愈加明显。

Stage IV (after 2015): the "Design-Build-Test" (DBT) cycle of synthetic biology extended to "Design-Build-Test-Learn" (DBTL), proposal of concepts or subjects such as "Semiconductor Synthetic Biology" and "Engineering Biology", and more obvious presentation of the integrated development of biological technology (BT) and information technology (IT).

设计与合成可预测的生命体，是合成生物学领域的核心科学问题。合成生命体往往具有高度复杂性，这决定了其需要海量的工程化试错性实验，即需要快速、低成本、多循环地完成DBTL这一闭环。如何通过自动化、机器学习以及大量生物数据的会聚来提高研究的发现、通量和产量成为合成生物技术进一步发展亟待解决的关键问题。

Designing and synthesizing predictable organisms is a core scientific issue in the field of synthetic biology. Synthetic organisms are often highly complex, which makes massive engineering trial-and-error experiments a must to complete the DBTL loop in a rapid, low-cost and multi-cycle way. How to improve the discovery, throughput, and yield of research through automation, machine learning, and convergence of massive biological data turns out a key problem to be solved in the further development of synthetic biotechnology.

02 合成生物产业现状
Status Quo of the Synthetic Biology Industry

2.1 英美等国家相关产业发展较好，掌握合成生物领域核心技术
2.1 Relevant industries have developed relatively well in the United Kingdom and the United States, which have mastered core technologies in the field of synthetic biology

当前，合成生物学产业迎来历史性发展机遇，应用领域迅猛拓展，作为其重要分支的合成生物自动化设施平台产业也乘势而起。迄今为止，美英两国已分别支持建设多个大型合成生物学研究中心；德国、荷兰、日本、新加坡、澳大利亚等国也启动合成生物学研究的布局。其中美国在合成生物研究方面具有先发优势，伊利诺伊大学香槟分校累计获得美国国防部、能源部、NIH和NSF超过2亿美元投资，建成全球首个自动合成生物功能岛。截至2020年9月，美国Ginkgo Bioworks公司、Zymergen公司等企业累计获得超过15亿美元风险投资，进行自动化合成生物研发。在合成生物自动化设施平台领域，合成生物自动化设备、机器人集成等核心技术主要由Thermo、Beckman、HiRes等国外公司掌控。

At present, the synthetic biology industry has ushered in a historic development opportunity, with its application scenarios expanded rapidly. One of its major branches, the synthetic biology automation facility platform industry, has also taken advantage of the trend. So far, the United States and the United Kingdom have respectively supported the construction of several large-scale synthetic biology research centers; Germany, the Netherlands, Japan, Singapore, Australia and other countries have also launched their layout in synthetic biology research. Among them, the United States boasts a first-mover advantage. Gaining over USD200 million of investment from the US Department of Defense, the US Department of Energy, NIH and NSF, the University of Illinois Urbana-Champaign has built the world's first automatic synthetic biological function island. As of September 2020, US-based companies such as Ginkgo Bioworks and Zymergen have garnered over USD1.5 billion venture capital for automated synthetic biology research and development. As to the field of synthetic biology automation facility platforms, the core technologies of synthetic biology automation equipment and robot integration are mainly controlled by foreign companies such as Thermo, Beckman, and HiRes.

2.2 我国合成生物平台型企业较少，工程化平台建设尚处起步阶段
2.2 China has less synthetic biology platform enterprises, with its construction of engineering platforms still in infancy

截至2019年，全球合成生物学公司已经超过730家。商业模式可分为产品型与平台型，产品型公司利用合成生物技术生产各领域所需产品；平台型公司以菌株改造及自动化平台为核心，通过整合相应技术提供高效且可复用的技术平台，实现从产品设计到微生物开发、最终规模化生产的进程。从长期角度来看，平台型企业更具发展潜力，但目前典型平台型企业主要分布在国外，如Amyris公司、Ginkgo Bioworks公司等，我国合成生物企业多以产品型为主。

As of 2019, there are more than 730 synthetic biology companies around the globe. The business models can be divided into the product-based and platform-based types. Product-based companies use synthetic biotechnology to produce products needed in various fields; platform-based ones see strain transformation and automation platforms as the core, and provide efficient and reusable technology platforms by integrating corresponding technologies, thus completing the loop from product design, microbial development, to large-scale production in the end. From a long-term perspective, platform-based companies have greater potential for development. Nevertheless, typical platform-based companies are mainly located in foreign countries, such as Amyris and Ginkgo Bioworks. Most Chinese synthetic biology companies are product-based.

2020年12月工程生物产业数据分析平台（EB Insights）发布的"全球最值得关注的50家合成生物学企业"中我国有杭州恩和生物、北京博雅辑因、北京合生基因、苏州泓迅科技、上海凯赛生物、北京蓝晶微生物、南京传奇生物、深圳森瑞斯生物、深圳鑫飞生物等9家企业入选。但是在合成生物学应用相关的多种工程技术平台建设，以及推动合成生物学技术成果转化的产学研创新价值链建设等核心问题上，还未形成重大突破口。如果没有产业共性技术平台、生物基因工程平台、企业的推力，合成生物技术成果产业化难以做大做强。

In December 2020, nine Chinese enterprises - Hangzhou Bota Biosciences, Beijing EdiGene, Beijing SynGene Tech, Suzhou Synbio Technologies, Shanghai Cathay Biotech, Beijing Bluepha, Nanjing Legend Biotech, Shenzhen Synceres, and Shenzhen Xinfei Biology - were included in the "50 Most Notable Synthetic Biology Companies in the World" released by EB Insights, an engineering biology industrial data analysis platform. However, no major breakthroughs have been made in core issues such as the construction of various engineering technology platforms related to the application of synthetic biology, and the construction of an industry-university-research innovation value chain that promotes the transformation of synthetic biotechnological achievements. Without generic technology industrial platforms, biological genetic engineering platforms, and relevant enterprises as the thrust, it is difficult to continuously promote the industrialization of synthetic biotechnology achievements.

SYNTHETIC BIOLOGY

03 合成生物产业市场前景
Market Prospects of Synthetic Biology Industry

3.1 多国重视技术部署，促进合成生物研究及应用不断深入
3.1 Many countries highlight the technology deployment to promote the continuous deepening of synthetic biology research and application

目前，合成生物学成为世界各国必争的科技战略高地，被纷纷纳入主要经济体的重点战略发展领域。例如，美国政府通过美国国家科学基金会（NSF）、国立卫生研究院（NIH）、农业部（USDA）、国防部（DOD）等联邦机构积极支持合成生物学的基础研究和技术研发；英国对于合成生物学制定了全链条的战略路线，从技术到产业、从本国到国际、从专家团体建设到人才培养体系均有详细的规划布局；德国合成生物学的发展得益于权威组织的引导、相关立法的及时匹配，使其目前仍然在国际合成生物学舞台处于第一梯队。

Today, synthetic biology has become a strategic stronghold for scientific and technological development that all countries are fighting for, which has been taken by major economies as a key field for strategic development. For example, the U.S. government offers strong support to the basic research and technological development of synthetic biology through such federal agencies as the National Science Foundation of the United States (NSF), National Institutes of Health (NIH), US Department of Agriculture (USDA), and US Department of Defense (DOD); the United Kingdom has formulated a full-chain strategic route for synthetic biology, with detailed planning and layout made from technology to industry, from home to abroad, from expert group construction to talent training system establishment; owing to the guidance of authoritative organizations and the timely passing of relevant legislation, Germany still stands in the first echelon for the development of synthetic biology.

纵观各国对于合成生物学及其相关产业的战略布局与政策规划，可以看出我国合成生物学发展举措是全方位的，包括政府管理机构与科技界的大量互动，持续规划部署相关产业的发展。得益于制度优势，当前我国合成生物学有着技术前瞻、政策稳定两大鲜明特点，使得合成生物自动化设施平台等相关产业具有巨大的发展势能。

Viewed from the strategic layout and policy planning of synthetic biology and related industries in various countries, it can be concluded that China has adopted all-round measures for the development of synthetic biology, such as the frequent interactions between government authorities and the science & technology society, and the continuous planning and deployment of the development of relevant industries. Blessed by the institutional advantages, China's synthetic biology currently has two distinctive features of forward-looking technology and policy stability, which offers the synthetic biology automation facility platform and other related industries huge development potential.

3.2 市场规模增长迅速，自动化等技术将继续推动行业发展
3.2 The market scale is growing rapidly, and technologies such as automation will continue to promote the industrial development

根据科技服务机构DeepTech深科技2021年的分析数据，2021年全球合成生物学市场规模达736.93亿美元，2016-2021年间合成生物学市场规模的年复合增长率(CAGR)达到83.6%。中国的合成生物学市场增长也较快，2016年市场规模为9亿美元，2020年24.78亿美元，2021年达到64亿美元，相比2020年以及之前增长约2-3倍。

According to the analysis data of DeepTech, a technology service organization, in 2021, the global synthetic biology market size reached USD73.693 billion in 2021, and the compound annual growth rate (CAGR) of the synthetic biology market size from 2016 to 2021 came to 83.6%. China's synthetic biology market is also growing rapidly, featuring a market size of USD900 million in 2016, USD2.478 billion in 2020, and USD6.4 billion in 2021, a 2-3 times increase compared to 2020 and before.

MARKET PROSPECTS

从资本市场表现来看，合成生物行业正在走向爆发期。首先，该领域市场空间巨大。合成生物学的应用范围广泛，涉及日常生活的方方面面，具备巨大的市场空间，随着市场渗透率的加快，爆炸性增长或将到来。其次，新技术涌现迅速。生物体设计的超高通量筛选平台、酶法DNA合成和新型基因编辑平台等新技术的发展推动着行业创新。此外，在所有获得融资的公司中，累积融资金额最高的10家公司分别围绕在医疗（Moderna Therapeutics、Precigen、Poseida Therapeutics）、食品及饮料开发（Impossible Foods、Perfect Day、Apeel Sciences）、生物体设计（Ginkgo Bioworks）、自动化生产平台（Amyris、Zymergen）及能源应用开发（Sapphire Energy）。可见合成生物的应用场景非常多元，展现出了巨大的应用潜力，且已具备成熟的市场规模。

Judged from the performance of the capital market, the synthetic biology industry is heading for an explosive period. First of all, it has a lucrative market potential. Synthetic biology has a wide range of applications, covering all aspects of daily life, and a huge market space. With the acceleration of market penetration, it will embrace an explosive growth. Second, new technologies are emerging rapidly. The development of new technologies such as organism-designed ultra-high-throughput screening platforms, enzymatic DNA synthesis, and novel gene editing platforms is driving the industrial innovation. In addition, among all financing beneficiaries, the 10 collecting the most are engaged in healthcare (Moderna Therapeutics, Precigen, and Poseida Therapeutics), food and beverage development (Impossible Foods, Perfect Day, and Apeel Sciences), biological design (Ginkgo Bioworks), automated production platforms (Amyris, and Zymergen) and energy application development (Sapphire Energy). It can be seen that synthetic biology embraces very diverse application scenarios, huge application potential, and a mature market scale.

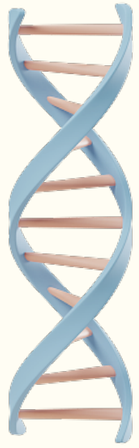
据预测，随着合成生物学技术的不断成熟以及相应的政策刺激，预计到2030-2040年，全球会有60%的经济物质投入是由生物（包括合成生物学）产生，并且将会影响的产值空间将达到1.8-3.6万亿美元；预计2040-2050年期间，全球会有70%的经济物质投入是由生物（包括合成生物学）产生，并且将会影响的产值空间将达到3.0-5.1万亿美元，行业发展前景广阔。

It is predicted that with the growing maturity of synthetic biotechnology and the stimulation of corresponding policies, 60% of the world's economic material input will be generated by biology (including synthetic biology) by 2030-2040, with USD1.8-3.6 trillion of output value to be impacted; 70% of the world's economic material input will be generated by biology (including synthetic biology) by 2040-2050, with USD3.0-5.1 trillion of output value to be impacted. A promising industrial prospect could thus be expected.

3.3 深度渗透多方应用，为医、农、食、工等行业注入动力
3.3 Deep penetration and omnidirectional applications inject impetus into medical, agricultural, food, industrial and other sectors

截止到2021年底，全球合成生物学相关市场行业整体爆发式增长，市场规模达到736.93亿美元，较2021年增长767.5%。增长最明显的是医疗领域，2021年市场规模达到687.24亿美元；其次是化工领域，合成生物学市场规模18.22亿美元；科研服务领域合成生物学市场规模18.11亿美元；农业领域合成生物学市场规模为4.97亿美元；食品领域合成生物学市场规模为5.08亿美元；其他领域合成生物学市场规模为3.31亿美元。据麦肯锡预测，未来在全球范围内医药健康领域受到的直接经济影响约占合成生物学总影响的35%。

By the end of 2021, the global synthetic biology related market and industry went through an explosive growth as a whole, amounting to a market size of USD73.693 billion, up 767.5% over 2021. Healthcare sector enjoyed the most obvious growth, its market size reaching USD68.724 billion in 2021; chemical industry came next to it, with a market size of USD1.822 billion for synthetic biology; the market size of synthetic biology in the field of scientific research services totaled USD1.811 billion; the synthetic biology market size added up to USD497 million in agriculture; the synthetic biology market size in the food sector came to USD508 million; the synthetic biology market size in other segments was valued USD331 million altogether. According to McKinsey's forecast, the medical and health sector will suffer 35% of the total direct economic impact imposed by synthetic biology on the globe.



领域 Field	2016年 2016	2017年 2017	2018年 2018	2019年 2019	2020年 2020	2021年 2021	复合增长率（%） Compound Growth Rate (%)
医疗 Healthcare	1870.4	2836.4	3084.9	3591.6	4629.6	68723.9	105.6
科研服务 Scientific research services	688.2	9721.41.7	1056.9	1113.7	1435.6	1811.1	21.4
化工 Chemical	571.7	850.9	925.5	1087.4	1401.6	1822.1	26.1
农业 Agriculture	151.7	225.9	234.7	296.6	382.3	496.9	26.8
食品 Food	141.2	210.1	228.5	303.1	390.8	508	29.2
其他 Other	105.9	157.6	171.4	197.7	254.8	331.3	25.6
总计 Total	3529.0	5252.5	5712.8	6590.1	8494.7	73693.3	83.6

表1 2016-2021年按终端用户分类的合成生物学市场规模（单位：百万美元，数据来源：DeepTech）

Table 1 Synthetic Biology Market Size by End User (2016-2021) (Unit: USD million, data source: DeepTech)

2021年中国合成生物学市场规模约为64.16亿美元，较2020增长39.38亿美元。在2021年和2022年，中国合成生物学获得的资本投入的均是医疗健康行业，涉及新材料、食品、生物技术和制药子行业，获得融资的企业有木槿化学、蓝晶微生物、智化科技、恩和生物、弈柯莱生物、酶赛生物、士泽生物、小熊猫生物、未名拾光生物、柯泰亚生物、微构工场、芝诺科技、柏垠生物、盈嘉合生等。

The market size of synthetic biology in China rose to approximately USD6.416 billion in 2021, an increase of USD3.938 billion from 2020. The capital investment for synthetic biology that China received in 2021 and 2022 was all aimed to the healthcare sector, as well as new materials, food, biotechnology and pharmaceutical sub-sectors. Financing beneficiaries include Mujin Chemical, Bluepha, ChemicalAI, Cynceres, Abiochem, Enzymaster, Xellsmart, Synbiopunk, Veminsyn, Ketaiya Bio, PhaBuilder, Zenotek, PAML Biotechnologies, Ingia-Bio, etc.

3.4 应用需求丰富多元，合成生物技术及产品市场潜力巨大

3.4 In response to rich and diverse application demands, synthetic biotechnology and product embrace huge market potential

从未来国民经济、社会发展和国防安全的战略目标分析，合成生物技术和产品未来将深刻影响人们的工作和生活方式。在环境方面，合成生物学具有在低碳经济中支撑经济增长和创造就业机会的巨大潜力；在人口健康方面，人工合成的活体药物可实现对人体生理状态的监测，以及对肿瘤、代谢疾病、耐药菌感染等典型疾病的诊断与治疗；在农业方面，合成生物学可用于研发高产、抗病、耐旱、耐涝和环保的植物原料；在军事方面，合成生物学可帮助我国提高军事战斗力、提高军用药物的治疗成效并保障军用物资充裕；在能源方面，能源转型和气候变化是本世纪人类面临的全球性问题，而这两者都与二氧化碳的排放和利用息息相关。基于合成生物学的生物制造具有易于大规模生产、条件温和、选择性好、环境友好等优点，其使用的底物原料通常为淀粉及其他含糖物质，减少化石能源的使用。此外，近年来基于木质纤维素等生物质的生物制造和基于二氧化碳的生物制造也在探索中不断发展，并取得了一定进展。

Analyzed from the strategic goals of national economy, social development and national defense, synthetic biotechnology and products will profoundly impact people's work and lifestyle in the future. On the environmental front, synthetic biology has great potential in sustaining economic growth and creating jobs in a low-carbon economy; in terms of human health, synthetic living drugs can monitor the physiological state of the human body, and diagnose and treat typical diseases such as cancer, metabolic diseases, and drug-resistant bacterial infections; as to agriculture, synthetic biology can be used to develop high-yield, disease-resistant, drought-tolerant, flood-proof, and environmentally friendly plant materials; in the military aspect, synthetic biology can help China improve its military combat effectiveness, refine the therapeutic effect of military drugs, and ensure sufficient provision of military supplies; with respect to the energy, energy transition and climate change are two global issues facing mankind in this century, both of which are closely related to the emission and utilization of carbon dioxide. Biomanufacturing based on synthetic biology boasts such advantages as convenience for large-scale production, mild conditions, good selectivity, and environmental friendliness, which generally uses starch and other sugar-containing substances as the substrate raw materials to reduce the use of fossil fuel. What's more, biomanufacturing based on biomass such as lignocellulose and on carbon dioxide have also advanced in exploration and made certain progress in recent years.

据估计，目前生物制造产品平均节能减排30%-50%，未来潜力将达到50%-70%，在面向未来碳达峰、碳中和目标的背景下，基于合成生物学的生物制造在工业、能源、农业、材料、环保等众多领域具有良好发展前景。合成生物底层技术的发展能够进一步拓宽先进生物技术前沿，各类合成生物自动化设施平台能够在极大程度上提升合成生物技术在以上领域中的应用效能，推动技术成果的创新与产业化，丰富多样的合成生物产品能够满足人们日益增长的多种需求，因此该行业市场潜力巨大，未来发展空间将迅速增长。

It is estimated that bio-manufactured products can save energy and reduce emission by 30%-50% in average now, and 50%-70% in the future. Against the future goals of carbon peaking and carbon neutrality, biomanufacturing based on synthetic biology has promising development prospect in fields of industry, energy, agriculture, materials, and environment. The development of synthetic biology underlying technologies can further expand the frontier of advanced biotechnology, various synthetic biology automation facilities and platforms can greatly improve the application efficiency of synthetic biotechnology in the above fields to promote the innovation and industrialization of technological achievements, and various synthetic biological products can meet the growing needs of people. All in all, the industry embraces huge market potential and fast-growing development space.

04 合成生物产业未来发展突破点

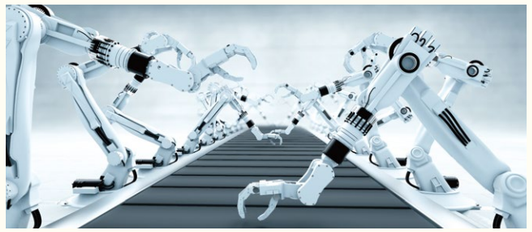
Breakthrough Points for Future Development of Synthetic Biology Industry

4.1 继续迭代优化现有设施平台以充分满足应用需求

4.1 Continue to iteratively optimize the existing facility platform to fully meet application requirements

当前，合成生物学产业化进程中最重要的自动化合成生物技术尚处在发展初期，英、美等国现有的自动化设施与工程化研究平台仍然存在一定的局限性，包括复杂线路设计能力不强、底盘细胞单一、大片段DNA的制造成本高、高通量测试手段少、与下游应用衔接不紧，等等。许多研发需求仍未能满足，领域的发展仍面临障碍。在此背景下，需要合成生物、自动化、分析化学、信息技术、人工智能等多领域的研究人员和工程师共同协作，进行自动化设施平台的多轮工程化迭代优化，为合成生物领域的基础与应用研究的快速发展提供支撑，并有望带来革命性影响。

At present, automated synthetic biology technology, the most important factor for the synthetic biology industrialization, is still in an early stage of development, and the existing automation facilities and engineering research platforms in UK, US and other countries still have certain limitations - weak ability to design complex circuits, simplex chassis cells, high cost for manufacturing of large DNA fragments, few high-throughput testing methods, loose connection with downstream applications, etc. Many R&D needs remain unmet, and the development of the field still faces obstacles. In this context, researchers and engineers in the field of synthetic biology, automation, analytical chemistry, information technology, and artificial intelligence need to work together to carry out multiple rounds of engineering iterative optimization of the automation facility platform, thus offering bolster for laying foundation and developing application research of the synthetic biology and possibly bringing in a revolutionary impact.



4.2 突破关键技术以推动合成生物产业的进一步发展

4.2 Breakthrough in key technologies to promote the further development of the synthetic biology industry

未来在合成生物领域，研究及工程化设施建设需要突破的关键技术包括：

For synthetic biology in the future, key technologies to be grasped in research and engineering facilities construction include:

❶ 自动化技术

(1) Automation technology

开发与高通量合成生物操作兼容的仪器设备、自动化物料转运机器人等硬件系统；开发"云端实验室软件"架构；实现设备互联互通、智能调度、动态监控、信息整合等。

Develop instruments and equipment, automated material transfer robots and other hardware systems compatible with the high-throughput synthetic biology operations; develop "Cloud Lab Software" architecture; realize equipment interconnection, intelligent scheduling, dynamic monitoring, information integration, etc.

❷ 智能设计技术

(2) Intelligent design technology

开发针对合成生物系统及其实验验证方案的计算机辅助设计方法，包括合成生物数据库知识库、数据驱动的合成生物设计预测算法和模型、实验方案规划（如实验原料、基因合成及组装策略、设备操作参数等）及指令集生成软件等；应特别针对自动化设施多循环、海量试错的特点，结合人工智能方法实现算法和模型的动态优化，提高合成生物研究效率。

Develop computer-aided design methods for synthetic biology systems and their experimental validation schemes, including the synthetic biology database knowledge base, data-driven synthetic biology design prediction algorithms and models, experimental scheme planning (such as experimental materials, gene synthesis and assembly strategies, and equipment operation parameters) and instruction set generation software; special attention should be paid to the multi-cycle and massive trial-and-error characteristics of automated facilities, combined with artificial intelligence methods, to achieve dynamic optimization of algorithms and models, and improve the efficiency of synthetic biology research.

❸ 合成生物支撑技术

(3) Synthetic biology support technology

开发与自动化流程适配的合成生物构建与测试技术，如大片段DNA合成与组装、非模式底盘转化与培养、高通量多维度光学与化学分析等，从而扩展工程化设施研究对象的范围和规模。

Develop synthetic biology construction and testing technologies suitable for automated processes, such as large-fragment DNA synthesis and assembly, non-modal chassis transformation and culture, and high-throughput multi-dimensional optical and chemical analysis, thereby expanding the scope and scale of research objects of engineering facilities.

4.3 完善政策制度与行业标准，为产业发展提供稳定的外部环境

4.3 Improve policy systems and industrial standards to provide a stable external environment for industrial development

合成生物自动化设施平台产业的健康可持续发展需要良好的外部环境予以支持和保障，例如，相关研发机构、高校、企业间组成联盟，研发通用的操作系统、自动化协议与标准以及统一的实验流程及数据处理标准，推动行业整体发展；各国(地区)政府与相关政府部门完善法律工具，健全法律法规，如跨国、跨机构的材料转移协议、知识产权共享协议等，为实验材料的共享降低成本，避免重复研发；围绕自动化设施提供云端服务，扩大用户群体，特别是中小企业用户；促进并加强国际自动化设施之间的协同，如共同承担国际大科学计划的研究任务，相互分担调配任务，与耗材供应商共同协商定价等。

The healthy and sustainable development of the synthetic biology automation facility platform industry requires the support and guarantee of a good external environment. For example, concerning R&D institutions, universities, and enterprises may form alliances to develop common operating systems, automation protocols and standards, and unified experimental procedures and data processing standards, so as to promote the overall development of the industry; governments of various countries (regions) and relevant departments should refine the legal tools and laws/regulations, such as the transnational and inter-institutional material transfer agreements, and intellectual property rights sharing agreements, to reduce costs for the sharing of experimental materials and avoid repeated research and development; provide cloud services centering around automation facilities to expand user groups, especially small and medium-sized enterprises; promote and strengthen the coordination between international automation facilities, such as jointly undertaking the research tasks of international major scientific programs, sharing deployed tasks with each other, and negotiating with consumable suppliers for the pricing.

KEY ENTERPRISES

05 重点企业

Key Enterprises

5.1 Amyris —— 业务布局多元的首家合成生物学领域平台型公司

5.1 Amyris - the first synthetic biology oriented platform company with a diversified business layout

Amyris由加州大学伯克利分校教授Jay D. Keasling等人创立，最初从事抗疟药物青蒿素及其他萜类化合物生产。Jay D. Keasling是合成生物学领域先驱和权威之一，在微生物的代谢工程改造方面研究积累深厚。Amyris成立之初即获得了美国盖茨基金会的4260万美元资金资助，并于2005年成功实现生物法生产抗疟药物青蒿素前体青蒿酸。Amyris公司利用合成生物学方法将植物中青蒿素合成相关基因优化并导入酿酒酵母中，酿酒酵母通过发酵蔗糖等底物即可高效合成青蒿素前体青蒿酸。利用该技术，Amyris能以100m工业发酵罐替代5万亩的农业种植。2008年Amyris将青蒿酸生产菌株免费授权给Sanofi，此后Sanofi于2013年结合化学合成实现大规模生产青蒿素。

amyris

Amyris, founded by Jay D. Keasling, a professor of UC Berkeley, et al., was initially engaged in the production of the antimalarial drug artemisinin and other terpenoids. Jay D. Keasling is one of the pioneers and authorities of synthetic biology, with extensive research in the metabolic engineering of microorganisms. Amyris received USD42.6 million funding from the Bill & Melinda Gates Foundation of the United States upon its inception, and successfully realized the biological production of artemisinic acid, the precursor of artemisinin, an antimalarial drug in 2005. Amyris uses synthetic biology methods to optimize the genes related to artemisinin synthesis in plants and introduce them into Saccharomyces cerevisiae that can efficiently synthesize artemisinic acid, the precursor of artemisinin, by fermenting substrates such as sucrose. With this technology, Amyris can supplant 50,000mu of agricultural planting with 100m industrial fermentaton tanks. Amyris licensed the artemisinic acid production strain to Sanofi for free in 2008, and Sanofi coupled it with chemical synthesis to realize large-scale production of artemisinin in 2013.

2010年，公司于纳斯达克上市，是合成生物学领域最早的上市公司。该公司自2012年起即开始搭建自动化菌株改造平台，是目前全球企业界最大型的工程化平台之一，涵盖DNA设计、DNA组装、DNA质量控制、菌株转化、克隆挑选、菌株质量控制、表型测试、高通量筛选、菌株保藏、数据分析、放大实验等功能。

In 2010, the company went listed on Nasdaq as the first in the field of synthetic biology. The company has been building its automated strain transformation platform, one of the largest engineering platforms in the corporate world around the globe, since 2012, which covers DNA design, DNA assembly, DNA quality control, strain transformation, clone selection, strain quality control, phenotype testing, high-throughput screening, strain preservation, data analysis, and amplification experiments.

5.2 Zymergen——合成生物学领域平台型巨头

5.2 Zymergen - a platform giant in the field of synthetic biology

Zymergen成立于2013年，总部位于加州埃默里维尔，是典型的合成生物学领域平台型公司。公司利用生化工具、机器学习、自动化等理论与技术研发创新产品与材料，经"设计-构建-测试-学习"的循环迭代最终完成从产品设计到规模化生产的进程。2021年4月22日，公司正式在纳斯达克上市。

Founded in 2013 and headquartered in Emeryville, California, Zymergen is a typical platform company in the field of synthetic biology. The company employs biochemical tools, machine learning, automation and other theories and technologies to develop innovative products and materials, and finally complete the process from product design to large-scale production through the "design-build-test-learn" cycle. The company went listed on Nasdaq on April 22, 2021.

公司正孕育处于不同开发阶段的10余款产品，涵盖电子、消费护理、农业领域。目前，公司已成功开发出Hyaline高光学质量PI薄膜产品，其展现出优良的透明度、柔性等性能，在可折叠显示器、触摸传感器面板等电子领域展现出广阔的应用前景。根据公司招股书，ZYM0107耐高温光学PI薄膜产品预计于今年发布，ZYM010高模量光学PI薄膜与ZYM0201天然驱虫剂产品预计于2023年发布。基于合成生物平台，Zymergen预计新产品推向市场总历时约5年，成本约5000万美元。品预计于今年发布，ZYM010高模量光学PI薄膜与ZYM0201天然驱虫剂产品预计于2023年发布。基于合成生物平台，Zymergen预计新产品推向市场总历时约5年，成本约5000万美元。

The company is incubating more than 10 products at various stages of development, covering electronics, consumer care, and agriculture. To date, the company has successfully developed the high optical quality PI film product Hyaline, which features broad application prospects in electronic fields such as foldable displays and touch sensor panels for its excellent transparency and flexibility. According to the company's prospectus, ZYM0107 high-temperature optical PI film is expected to be released this year, and ZYM010 high-modulus optical PI film and ZYM0201 natural insect repellent are scheduled to be available in 2023. Based on the synthetic biology platform, Zymergen expects to release its new product to the market in about five years at a cost of roughly USD50 million.

Zymergen尚未从产品销售中获得收入，当前收入主要来源于研发服务协议和合作收益。2021年前三个季度，公司实现营收1370万美元，其中研发服务协议收入占比为76.2%，对外合作收入占比为23.8%。此外，由于下游市场推广受阻，公司首款产品Hyaline的预期销售延缓，2021年前三个季度，公司净亏损增加至2.6亿美元。因此，尽管公司已经实现自动化、机器学习和合成生物学的技术融合，真正到应用层面仍需考虑后续产品落地和量产的难度。

Zymergen has not yet got returns from product sales, and its current income is primarily derived from R&D service agreements and collaboration benefits. In the first three quarters of 2021, the company achieved a revenue of USD13.7 million, of which R&D service agreement accounted for 76.2% and external cooperation contributed 23.8%. Furthermore, the company's net loss increased to USD260 million in the first three quarters of 2021 due to the delay in sales of the company's first product, Hyaline, and the hindered market promotion downstream. Therefore, although the company has realized the technical integration of automation, machine learning and synthetic biology, it is still necessary to consider the difficulty in subsequent marketizing and mass production of products at the application level.

5.3 Ginkgo Bioworks——致力于生物铸造平台的独角兽企业

5.3 Ginkgo Bioworks - a unicorn company dedicated to biofoundry platforms

Ginkgo Bioworks成立于2009年，是一家专注于生物铸造厂、代码库以及由此产生的下游价值的合成生物独角兽企业，由麻省理工学院合成生物学领域专家Tom Knight教授及几位研究生于美国波士顿创立，以为客户提供微生物的研发服务为主要业务，致力于对微生物进行基因改造用于生产高端化学材料或优化化工业生产。2021年5月，Ginkgo Bioworks通过SPAC在纽约交易所上市。

Founded in 2009, Ginkgo Bioworks is a synthetic biology unicorn company focusing on biofoundries, code bases and the resulting downstream businesses. Incorporated in Boston, USA by Professor Tom Knight and some postgraduates from the Massachusetts Institute of Technology, it aims to provide customers with microbial research and development services, and genetically modify the microorganisms for the production of high-end chemical materials or optimization of production in the chemical industry. In May 2021, Ginkgo Bioworks went listed on the New York Stock Exchange through a SPAC.

Ginkgo Bioworks核心竞争力为其生物铸造平台，包括生物铸造厂和代码库。前者形象地来说一个巨大且高效的生物实验室，借助生物铸造平台的软硬件及自动化技术，实施标准化的细胞改造；后者是包含海量基因序列的生物数据库，为生物铸造厂提供可重复使用的基因元件，公司的代码库目前囊括了开源的34亿基因序列以及独有的4.4亿基因序列。依靠生物铸造平台，公司能够高通量生产和评估菌株，根据客户规格执行各种各样的细胞编程。

Ginkgo Bioworks' core competency is its biofoundry platforms, including the biofoundry and the code base. The former is a huge and efficient biological laboratory, which implements standardized cell transformation with the assistance of the software, hardware and automation technology of the biofoundry platform; the latter is a biological database that contains massive gene sequences, providing reusable genetic elements for the biofoundry. The company's code base currently includes 3.4 billion open source gene sequences and 440 million unique gene sequences. Leveraging the biofoundry platform, the company can produce and evaluate strains in a high-throughput manner, and complete various cell programming tasks according to customers' specifications.

Ginkgo Bioworks目前仍处于亏损状态，但生物铸造平台的快速发展使得公司营收呈现高速增长趋势。2020年，尽管公司经营受到全球新冠疫情的影响，实现7670万美元营收，相较于2019年的5420万美元增长42%。2021年以来，公司营收大幅提升，前三季度达1.65亿美元，同比增长271%。预计未来Ginkgo Bioworks的生物铸造厂的代工收入和新项目的增长将继续推升公司业绩，实现扭亏为盈。

Ginkgo Bioworks is still in deficit, but the rapid development of the biofoundry platform has fueled the fast growth in the company's revenue. Despite of the impact by COVID-19, the company earned a revenue of USD76.7 million in 2020, up 42% compared with the USD54.2 million yielded in 2019. The company's revenue has increased significantly since 2021, reaching USD165 million in the first three quarters, a year-on-year increase of 271%. It is expected that in the future, the revenue growth in biofoundry's OEM service and new projects of Ginkgo Bioworks will continue to push up the company's income and turn losses into profits.

5.4 恩和生物——国内头部合成生物技术平开发商

5.4 Bota Bio - a leading developer of synthetic biotechnology in China

恩和生物（Bota Bio）以计算为基础，搭建了酶工程、菌株工程和发酵工艺工程平台，涵盖生物催化、生物转化和生物全合成三大技术路径。同时，Bota Bio还开发了适用于生物技术开发和生产的云端数据库和智能化控制软件，并把实验室中的自动化和高通量硬件设施整合进去，完整记录整个工作流程中样品和信息之间的关联。

On the basis of computing, Bota Bio has built a platform for enzyme engineering, strain engineering and fermentation process engineering, which covers three technical paths of biocatalysis, biotransformation and total biosynthesis. Meanwhile, it has developed a cloud database and intelligent control software suitable for biotechnology development and production, and integrated automation and high-throughput hardware facilities in the laboratory to completely record the relationship between samples and information throughout the workflow.

目前，恩和生物通过其自主开发的工业生物技术平台进行生物产品的高效开发，涵盖了化学、营养、制药等各个应用领域。Bota Bio有着高度创新的集成自动化平台，这无疑将极大加速产品的开发。此外。通过 Bota Bio的创新发酵工艺，产能能够得到预测和放大，这也使得实现商业化成为可能。

By far, the company is carrying out efficient development of biological products through its self-developed industrial biotechnology platform, which covers various application scenarios such as chemistry, nutrition, and pharmaceuticals. Bota Bio has a highly innovative integrated automation platform, which greatly accelerates the product development. What's more, its innovative fermentation process can predict and ramp up the production capacity, thus making commercialization possible.

5.5 森瑞斯生物——国内合成生物学平台型企业代表

5.5 Synceres - a representative of domestic synthetic biology platform enterprises

森瑞斯生物公司拥有先进的合成生物学实验室，主要以微生物为细胞工厂，借助工程科学概念，通过基因组合成、基因调控网络及信号转导通路的逻辑性设计和定向进化，人工创造具有功能的新途径或新型酶，生产各种活性成分产品。产品包括生物药物、营养药品、新型烟草、化妆品、香料、燃料、农业有机肥料、饲料等，应用领域十分广泛。

Synceres owns an advanced synthetic biology laboratory. With microorganisms as cell factories, it adopts the engineering concepts, and the logic design and directional evolution of gene group composition, gene regulation network and signal transduction pathway, to artificially create new functional pathways or enzymes and produce various products with active ingredients. Its products, including biological drugs, nutritional drugs, new tobacco, cosmetics, spices, fuels, agricultural organic fertilizers, and feeds, are used in a wide range of fields.

生物合成大麻二酚（CBD）与大麻萜酚（CBG），是森瑞斯生物已经推进落地的一个方向。公司已经申请了生物合成大麻素的相关专利，未来在该细分领域的主要目标市场会面向海外。此外，森瑞斯生物也在开发推进其他一些高附加值产品管线，比如液体新材料橡胶的生物合成。液体新材料橡胶是一种橡胶的添加剂，能够起到提升橡胶使用性能的作用，市场对该类产品的需求很大。目前森瑞斯公司已经能够做到该类产品的量产，并已经向下游部分市场提供了相关样品。

Biosynthesis of cannabidiol (CBD) and cannabigerol (CBG) is a direction where Synceres has already made efforts to advance. The company has applied for patents for the biosynthetic cannabinoids, and will shift its focus on this segment to overseas markets in the future. In addition, it is also developing and advancing other high value-added product pipelines, such as the biosynthesis of liquid new-material rubber. Liquid new-material rubber is a kind of rubber additive that can improve the performance of rubber, which enjoys massive market demands. So far, the company has managed to mass-produce such products, and provided relevant samples to some markets downstream.

06 小结 Summary

当前，全球合成生物产业市场规模在各类应用需求的驱动下迅速增长，生物体设计的超高通量筛选平台、酶法DNA合成和新型基因编辑平台等新技正处于爆发期，推动产业快速发展。合成生物学已经成为世界各国必争的科技战略高地，被纷纷纳入主要经济体的重点战略发展领域，从各国合成生物学战略布局来看，美国、英国、中国构建了较为完善的政策规划体系，处于国际合成生物舞台第一梯队。我国政府管理部门与科研院所、高校、企业在合成生物领域开展了大量互动，持续规划部署相关产业的发展，为合成生物自动化设施平台产业营造了良好的外部发展环境。即便现阶段国内合成生物学还处于发展初期，完成了一定的人才和技术积累。未来，受广阔的市场需求和多元的供给格局影响，在技术、政策、资金的加持下，合成生物技术将在化工、能源、材料、农业、医学、环境、食品等多个领域为不断涌入的创业者开拓一片新的"掘金之地"。

Driven by various application demands, the market scale of the global synthetic biology industry is growing rapidly today. New technologies such as ultra-high-throughput screening platforms for organism design, enzymatic DNA synthesis and novel gene editing platforms are at an explosion period, which helps propel the rapid development of the industry. Synthetic biology has become a strategic stronghold for scientific and technological development of all countries, and taken as a key strategic development field by major economies. Viewed from the strategic layout of synthetic biology, the United States, the United Kingdom, and China have established relatively complete policy planning systems as members of the first echelon. Chinese governmental departments have launched frequent interactions with scientific research institutes, universities, and enterprises in the field of synthetic biology, and constantly planned and deployed the development of related industries, thereby creating a good external development environment for the synthetic biology automation facility platform industry. Though at an early stage of development, the domestic synthetic biology sector has completed certain accumulation of talents and technologies. Dictated by the extensive market demands and diversified supply-demand patterns, synthetic biotechnologies will soon create a new "gold rush" for entrepreneurs in fields of chemical, energy, materials, agriculture, medicine, environment, and food as powered by technologies, policies and fund.

05 深度访谈
In-depth Interview

专 访

四川盈嘉合生科技有限公司
总经理 裴亮

Interview with Pei Liang, General Manager of
Sichuan Ingia Biosynthetic Co., Ltd.

从生物发酵甜味剂开发
窥见合成生物学产业现状

The status quo of biosynthetic industry
from the development of biofermentative sweeteners

专家简介：

PROFILE OF THE EXPERT

裴亮，四川盈嘉合生科技有限公司（以下简称"盈嘉合生"）总经理，复旦大学生物化学与分子生物学专业毕业，在提取、发酵和生产技术优化方面有超过20年的经验，负责公司研发和对外技术合作。盈嘉合生成立于2015年，专注于用合成生物学技术制造天然产物，产品广泛应用于医药、医美、营养保健、食品饮料等行业，在国内率先实现了天然产物的合成生物制造。

Pei Liang, General Manager of Sichuan Ingia Biosynthetic Co., Ltd. (hereinafter referred to as "INGIA"), graduated from Fudan University majoring in biochemistry and molecular biology. He has more than 20 years of experience in the optimization of extraction, fermentation and production technologies. Now, he is responsible for research and development and foreign technical cooperation in INGIA. Founded in 2015, INGIA focuses on using biosynthetic technology to manufacture natural products, which are widely used in medicine, medical beauty, nutrition and health care, food and beverage and other industries. It is the first in China to realize the biosynthetic manufacturing of natural products.

"合成生物学"被美国国防部列为未来重点关注的六大颠覆性基础研究领域，有望掀起第三次生物技术革命。近两年，"合成生物学"也在我国政府规划中频频出现，除了被国家"十四五"规划提及，成都市"十四五"规划《纲要》提到要超前布局合成生物前沿技术，并培育合成生物产业集群，此外还单独发布了《成都市"十四五"生物经济发展规划》，对合成生物学进行了重点描述。本期，我们邀请到合成生物学企业盈嘉合生的总经理裴亮，围绕合成生物学相关的基础研究、技术进展、转化应用等进行领域介绍和观点分享。

"Synthetic biology" has been listed by the US Department of Defense as the six most disruptive basic research fields to be focused on in the future, and is expected to set off the third biotechnology revolution. In the past two years, "synthetic biology" has also appeared frequently in the Chinese government planning. In addition to being mentioned in the national 14th Five-Year Plan, the Outline of Chengdu's 14th Five-Year Plan mentioned that the biosynthetic frontier technologies should be deployed in advance and the biosynthetic industry cluster should be cultivated. Furthermore, the Chengdu 14th Five-Year Plan of Bioeconomic Development was released separately, emphatically describing the synthetic biology. In this issue, we invited Pei Liang, the general manager of INGIA, a biosynthetic enterprise, to introduce and share his views on the basic research, technological progress, and translational applications related to synthetic biology.

近两年，尤其在国家、地方政府发布的产业规划点名"合成生物学"之后，合成生物学逐渐"火热了"起来，您认为背后的原因是什么？

In the past two years, synthetic biology has become increasingly "hot", especially after the industrial plans issued by the state and the local government mentioned "synthetic biology". What do you think is the reason behind this?

BIO Collaborate

裴亮 Pei Liang

合成生物学从加州大学伯克利分校Jay Keasling成功实现抗疟药青蒿素半合成开始，风靡全球。尤其在美国，合成生物学一直被业界人士关注着，在若干轮跌宕起伏中逐渐发展起来。它从开始过热，到逐渐热度降低，到再次成为聚光灯下的焦点，实际上伴随着一些关键技术的突破。

Synthetic biology has swept the world since Jay Keasling of the University of California, Berkeley, successfully semi-synthesized the antimalarial drug artemisinin. Synthetic biology, especially in the United States, has been on the radar of the industry, with several ups and downs. Its initial overheating, gradual cooling, and return to the spotlight were actually accompanied by some key technological breakthroughs.

以青蒿素为例，合成生物学鼻祖Amyris公司在本世纪初投入了上百名博士研究人员，斥资4000多万美元，希望借助合成生物学方法来生产青蒿素，虽然成功研发出能够产生青蒿酸的酵母菌株，取得了第一个发展里程碑，但最终也没有成功实现青蒿素的商业化生物合成。这是因为后来大量非洲农民已经通过传统种植手段提取生产了青蒿素，并且成本低于生物合成方法。因此Amyris的商业神话就此破碎，合成生物学热度也逐渐下降。近两年，合成生物学又在世界范围内得到广泛关注，这是因为合成生物学在生物技术前沿的拓宽下又迎来了技术发展的突破阶段，技术可行性得到提升，规模化应用也越来越多。到今天，早已超越科研范畴，走上工程化之路，成为了面向生产的工业生物技术。它综合各个学科的底层技术来解决生产中的实际问题，如结构学、各种组学以及一些工程学科，是多学科的交叉融合，因此走到了台前，受到广泛关注。

Taking artemisinin as an example, Amyris, the originator of synthetic biology, invested hundreds of doctoral researchers and more than USD 40 million in the early 2000s, hoping to use biosynthetic methods to produce artemisinin. Although a yeast strain capable of producing artemisinic acid was successfully developed, which achieved its first development milestone, ultimately the commercial biosynthesis of artemisinin was not successfully achieved. This is because artemisinin had since been produced by a large number of African farmers using conventional cultivation methods and at a lower cost than biosynthetic methods. As a result, the business myth of Amyris collapsed, and synthetic biology became less popular. In recent two years, synthetic biology has attracted extensive attention around the world. This is because synthetic biology has ushered in a breakthrough stage of technological development with the expansion of frontier biotechnologies. The technical feasibility has been improved, and more and more large-scale applications have been applied. Today, it has gone beyond the scope of scientific research and embarked on the road of engineering, becoming a production-oriented industrial biotechnology. It integrates the underlying technologies of various disciplines to solve practical problems in production, such as structural science, various omics and some engineering disciplines, so it is a cross-integration of multiple disciplines and has come to the forefront and attracted wide attention.

合成生物学相关的企业目前来看主要分两类，一类侧重平台搭建提供技术服务，另一类则有着自己的产品开发管线，您如何看待这两类企业的未来发展？？

Synthetic biology-related enterprises are mainly divided into two categories. One focuses on platform construction and provides technical services, and the other has their own product development lines. How do you view the future development of these two types of enterprises?

BIO Collaborate

目前，合成生物学的底层技术主要是美国开发的。很多从美国归来创业的技术研发专家都能相对容易得拿到融资。但研发出身的他们对合成生物学的工程学属性认识不足，导致其忽略了产品布局的重要性，这在一定程度上有违合成生物产业的初衷。国内很多企业构建合成生物学平台，以原件筛选、原件构建、微生物构建为服务内容。但实际上，这些技术过于底层，无论是发文章还是写专利，一旦涉足产业，我认为必须要有自己的产品，才能走市场化进程，仅靠投资人的资金投入无法维持企业长久稳定的发展。提供技术服务能够在短期支撑企业发展，但从长远角度来看，还是需要有自己的产品才能走得更远。比如华大基因，它从初期的技术服务供应商已蜕变为拥有众多独家产品的产品供应商，这也是合成生物学企业的发展趋势。

At present, the underlying technologies of synthetic biology are largely developed in the United States. Many technology specialists returning from the U.S. to start businesses have relatively easy access to financing. However, their lack of understanding of the engineering nature of synthetic biology leads them to ignore the importance of product layout, which goes against the original intention of the biosynthetic industry to a certain extent. Many domestic enterprises build biosynthetic platforms, with original screening, original construction, and microbial construction as the service content. But in fact, these technologies are too low-level. Whether it is to publish articles or to write patents, once they set foot in the industry, I think they must have their own products to take the marketization process. The long-term and stable development of the enterprise cannot be maintained only by the capital investment of investors. Providing technical services can support the development of enterprises in the short term, but in the long term, it is necessary to have own products to go further. BGI, for example, has transformed from a technical service provider to a product provider with many exclusive products, which is also the development trend of biosynthetic enterprises.

对比传统的化学合成，合成生物学的技术优势有哪些？

What are the technical advantages of synthetic biology over conventional chemical synthesis?

把合成生物技术和化学合成相比，实际上是将发酵罐和提取罐、反应釜进行对比。发酵罐如果能在反应条件、成本控制等方面超越提取罐和反应釜，则证明合成生物学的在医药食品领域的优势。目前，有很多天然产物在自然界中的丰度很低，难以实现产业化提取和化学合成生产。对于合成生物学来说，首先，能够在发酵罐中将其制备出来，并且这种工艺流程的成本远低于直接从植物中提取。原来需要种植千亩作物来提取的天然产物量，现在只需要一个发酵罐就能实现，节约了宝贵的耕地面积。同时，植物提取过程中其实浪费了很多原材料，比如甜叶菊，叶子中甜菊糖含量很高，但提取时仅能获取到10%的目标提取物，剩余的90%都是废渣，合成生物学技术也避免了这类资源浪费。此外，通过特殊生物技术还能对目标产物进行进一步修饰，改良其口感和味道，提升产品价值，提高利润。未来，盈嘉合生也将从半发酵向全发酵进军，逐渐摆脱原料依赖，形成完整的发酵生产线。可能在进入全发酵阶段的初期，我们的成本还处于高位，但根据经验来看，随着合成生物学方法升级迭代，成本将逐渐降低，顺利市场化。

To compare biosynthetic technology with chemical synthesis is to compare a fermenter with an extraction tank and a reaction kettle. If the fermenter can surpass the extraction tank and the reaction kettle in terms of reaction conditions and cost control, it will prove the advantages of synthetic biology in the field of medicine and food. At present, the abundance of many natural products in nature is very low, so it is difficult to achieve industrial extraction and chemical synthesis production. For synthetic biology, first, it can be prepared in a fermenter, and the cost of this process is much lower than direct extraction from plants. The amount of natural products that used to be extracted by planting thousands of mu of crops can now be achieved with a single fermenter, saving valuable arable land. In addition, a lot of raw materials are actually wasted in the process of plant extraction. For example, stevia has a high content of stevioside in the leaves, but only 10% of the target extract can be obtained during extraction, and the remaining 90% is waste residue. Such waste of resources is also avoided through biosynthetic technology. In addition, through special biotechnology, the target product can be further modified to improve its taste and flavor, enhance product value and increase profits. In the future, INGIA will also move from semi-fermentation to full-fermentation, gradually get rid of the dependence on raw materials, and form a complete fermentation production line. In the initial stage of full-fermentation, our cost is still high, but based on experience, with the upgrade and iteration of biosynthetic methods, the cost will be gradually reduced and the technology will be marketized smoothly.

此外，合成生物学对传统行业的渗透也体现了其优势。如肠道微生物、活菌治疗、生物基材料等的开发生产，都能归属到合成生物学中。通俗来说，就是用发酵罐来替代来干原来各个行业的传统工艺，潜力十足。

In addition, the penetration of synthetic biology into traditional industries also shows its advantages. For example, the development and production of intestinal microbes, viable bacteria therapy and bio-based materials can be attributed to synthetic biology. Generally speaking, it is to replace with the fermenter to complete the original traditional process of various industries, which has great potentials.

近期，在盈嘉合生产品开发进程中，是否有一些挑战或取得的突破跟大家分享？

Recently, do you have any challenges or breakthroughs to share with us in the product development process of INGIA?

由于合成生物学属于一种交叉学科，侧重于利用工程学技术来解决生产中的实际问题。交叉点越多，能够对生产过程进行改性的可能性就越大，既能在酶分子结构上做调整，也能在细胞构建时行改进。目前在食品中使用的代糖主要以赤藓糖醇为主，它属于糖醇类，味道较好，但食用过量会导致腹泻，阿洛酮糖作为接替它的下一代甜味剂，优点明显。除了不会引起腹泻，还能带给人们愉悦的大脑感受。我们在开发阿洛酮糖的过程中，就做了很多对酶的改进工作，聚焦3个关键研究工作：一是外源底物如何进入细胞，二是如何再从细胞中转移出去，三则涉及能量的传递。这一完整过程如何被改进地更顺畅，是合成生物学技术所关注的重点。催化生产阿洛酮糖的酶结构和种类是众所周知的，我们对其进行了耐热性和细胞牵引力的提升，迭代多次，最近取得的一个突破是将其转化率从24%提升到了32%，并且成本也比初期降低了30%。这是我们各个团队通力协作的成果，值得庆祝。

Since synthetic biology is an interdisciplinary subject, it focuses on using engineering techniques to solve practical problems in production. The more intersections it has, the more likely it is to be able to modify the production process, both to tweak the molecular structure of the enzyme and to improve the structure of cells as they are built. At present, erythritol is the main sugar substitute used in food, which belongs to sugar alcohols and has good taste, but excessive consumption will lead to diarrhea. Allulose, as the next-generation sweetener to replace it, has obvious advantages. In addition to not causing diarrhea, it can give people a pleasant feeling in the brain. In the process of developing allulose, we have done a lot of improvement work on enzymes, focusing on three key research tasks. First, how exogenous substrates enter cells, second, how they are transferred out of cells, and third, how the energy is transferred. How this whole process can be improved to run more smoothly is the focus of biosynthetic technology. The structure and type of enzyme catalyzing the production of allulose are well known. We have improved its heat resistance and cell traction force with several iterations. A recent breakthrough is that the conversion rate of allulose has been increased from 24% to 32%, and the cost has been reduced by 30% compared with the initial stage. This is the result of collaborative effort by our teams and should be celebrated.

盈嘉合生在今年3月获得了毅达资本的独家投资，您能谈谈是哪些因素促成了这笔融资吗？

INGIA received an exclusive investment from Addor Capital in March this year. Can you talk about what factors contributed to this financing?

BIO Collaborate

公司的业务面较广，首推产品甜味剂，包括甜菊糖苷、阿洛酮糖，以及未来将进行研发生产的罗汉果苷等品种。在这一领域，我们起步早，2000年创始人华君董事长就已经开始从事甜味剂的研发生产，并在积累了一定人脉和资源。能够得到投资机构认可，我认为还有以下三点因素的影响：一是我们所采用的技术手段属于合成生物学，是目前资本热度较高的一个领域；二个我们做出了具有一定市场竞争力的上市产品，并且通过技术升级能够实现成本的大幅降低，颠覆行业市场；三是我们在成果转移转化方面具有结构完整的团队和丰富的产业化经验，实践了技术"变现"。盈嘉合生的团队，在上游研发有中科院植生所王勇老师带领的科学家团队，中游是经验丰富的转移转化团队，下游有负责打开市场的专业营销团队。在投资人的支持下，未来盈嘉合生仍然会在甜味剂领域继续深耕，做大做强；同时，开发香兰素、柠檬烯等香精香料品种，并以核酸类药物中间体尿苷原料的生产打开生物医药板块。

The company has a wide range of business, and the first products are sweeteners, including stevioside, allulose, and mogrosides that will be developed and produced in the future. In this field, we started early. In 2000, the founder, Chairman Hua Jun, began to engage in the research and development and production of sweeteners, and accumulated interpersonal connections and resources. To be recognized by investment institutions, I think there are the following three factors. First, the technical means we use is synthetic biology, which is a field with great capital enthusiasm. Second, we have made marketed products with certain competitiveness, and through technological upgrading, we can achieve a substantial cost reduction and subvert the industry market. Third, we have a well-structured team and rich industrial experience in the transfer and transformation of achievements to practice technology "realization". In the upstream R&D, INGIA has a team of scientists led by Professor Wang Yong from Institute of Plant Physiology and Ecology, Chinese Academy of Sciences. In the midstream R&D, we have an experienced transfer and transformation team. In the downstream R&D, we have a professional marketing team responsible for expanding the market. With the support of investors, INGIA will continue to develop in the field of sweeteners and become bigger and stronger in the future. At the same time, we will develop flavors and fragrances such as vanillin and limonene, and explore the biomedical sector with the production of uridine, a nucleic acid drug intermediate.

目前，成都合成生物产业发展现状是怎样的？

What is the current status of biosynthetic industry in Chengdu?

BIO Collaborate

BIOSYNTHETIC INDUSTRY

在全国范围来看，整个西南地区的合成生物学产业还处于发展初期，一是企业实力不强，二是热度没有东部沿海高。深圳单独把合成生物学作为一个产业类别来支持发展，而成都则将合成生物纳入生物医药板块进行布局。但实际上，合成生物学在各行各业都有渗透，将其纳入生物医药领域可能不利于其未来的快速发展。在川渝传统发酵和生物制造产业的已有基础上，如何把合成生物市场做大，不能只局限于生物医药，更应该依托已有基础，选取市场潜力大的产品品种，力争突破，来扩大产业影响力，发挥带动作用。

On a national scale, the biosynthetic industry in southwest China is still in the early stage of development. The strength of the enterprises is not strong, and the popularity is not as high as that in the eastern coastal areas. Shenzhen is supporting the development of synthetic biology as an industry category, while Chengdu is integrating synthetic biology into the biomedical sector. But in reality, synthetic biology is pervasive in all walks of life, and its inclusion in the biomedical field may be detrimental to its rapid development in the future. On the basis of the traditional fermentation and biological manufacturing industries in Sichuan and Chongqing, how to expand the biosynthetic market should not be limited to biomedicine, but should rely on the existing foundation to select products with great market potential and strive to make breakthroughs, so as to expand the industrial influence and provide development motivation.

从合成生物产业的原材料供应来看，西南地区还未形成完整的上下游产业链，很多发酵原料还需要从其他地区采购。但从人才积累来看，成都传统发酵企业众多，设备设施以及技术人员都较为充足，还具有川西高原这样的产业腹地，能够一定程度解决能源动力、冷却发酵的冷水资源问题，优势明显。

In terms of raw materials supplied for the biosynthetic industry, a complete upstream and downstream industrial chain has not yet been formed in southwest China, and many fermentation materials need to be purchased from other regions. However, in terms of talent accumulation, Chengdu has many traditional fermentation enterprises with adequate equipment, facilities and technical personnel. It also has an industrial hinterland such as the Western Sichuan Plateau, which can solve the problems of energy power and cold water resources for cooling and fermentation, having obvious advantages.

此外，四川是农牧业大省，跟未来合成生物学最容易进入的兽药、农药和饲料领域密切相关，这类产品本省市场空间很大，在合成生物技术的加持下有望实现产业升级。虽然中西部和东南沿海地区在研发和生产上仍有一定差距，但我认为在合成生物产业上，成都发展后劲十足，一是不缺人才，二具有得天独厚的产业基础。未来，在成都本土开展研发工作，在周边地区进行生产加工，同时利用合成生物技术对四川地区的传统行业进行升级，如饲料生产，以及接地气的豆瓣酱、泡菜生产等，助力食品安全和营养健康，我相信合成生物这个产业将很快被带动起来。

In addition, Sichuan is a major province of agriculture and animal husbandry, which is closely related to the fields of veterinary drugs, pesticides and feeds that are most accessible to synthetic biology in the future. There is a large market space for such products in the province, and with the help of biosynthetic technology, it is expected to achieve industrial upgrading. Although there is still a gap in R&D and production between the central and western regions and the southeastern coastal regions, I think that Chengdu has a strong development potential in the biosynthetic industry, because there is no shortage of talents, and it has a unique industrial foundation. In the future, we will carry out research and development in Chengdu and production and processing in the surrounding areas. At the same time, we will use biosynthetic technology to upgrade traditional industries in Sichuan, such as feed production, as well as the production of popular bean paste and pickles to promote food safety and nutrition. I believe that the biosynthetic industry will soon be driven up.

06 企业风采
Corporate Style

INGIA 盈嘉合生

四川盈嘉合生科技有限公司
Sichuan Ingia Biosynthetic Co., Ltd.

四川盈嘉合生科技有限公司正式成立于2015年，是世界领先的甜菊糖苷生物生产企业之一，拥有国内最大的天然产物合成生物学研发和生产平台。公司专注于将合成生物学技术应用到天然活性成分的绿色智造，替代传统的植物提取，既是行业先行者，也是行业唯一同时具备生物合成和植物提取双技术体系的公司。

Sichuan Ingia Biosynthetic Co., Ltd. (Ingia-Bio for short), one of the world's leading bio-manufacturers of steviol glycosides as incorporated in 2015, owns China's largest synthetic biology R&D and production platform for natural products. An industrial leader and the only practitioner that has both the biosynthesis and plant extraction technological systems, the company is devoted to applying the synthetic biology technology to the green intelligent manufacturing of natural active ingredients, so as to supplant traditional plant extraction.

现有产品包括辅酶Q10、新型甜菊糖苷、β-烟酰胺单核苷酸（简称NMN）香兰素、罗汉果等，公司产品管线覆盖制药、保健品和食品多个领域。公司产品取得美国FDA、GRAS认证、ISO9001、FSSC22000、HALAL、KOSHER、NON-GMO认证等。公司立足于大健康产业，秉承专业、创新、优质、高效的服务理念，与国内外一些知名食品饮料、健康产品和医药企业建立了良好的合作关系。

The company's existing product offerings include coenzyme Q10, new steviol glycosides, β-nicotinamide mononucleotide (NMN) vanillin, and Siraitia grosvenorii, which cover such fields as pharmaceuticals, health care products and food. Our products have been approved by the US FDA, GRAS certification, ISO9001, FSSC22000, HALAL, KOSHER, NON-GMO certification, etc. Based on the big health industry and adhering to the professional, innovative, high-quality and efficient service concept, the company has established good partnership with some well-known food and beverage, health products and pharmaceutical companies at home and abroad.

公司与中科院上海生命科学研究院、天津工业生物技术研究院、四川大学、四川农业大学等科研院所建立了良好的合作关系。公司骨干技术人员在合成生物研究、发酵生产、分离纯化、分析测试等关键方面都各有特长。公司十分注重研发投入，先后完成了生物合成甜菊糖苷（D&M）、香兰素、阿洛酮糖的研发，在甜菊糖苷的产业化过程中积累了丰富的合成生物学成果转化经验，是国内少有的具备合成生物技术产业研发和生产实践能力的公司。盈嘉合生公司拥有19项授权专利，其中国外发明专利4项，中国发明专利4项，实用新型专利11项，另有7项发明专利在申请过程中。

The company has fixed favorable cooperation relations with Shanghai Institutes for Biological Sciences, Tianjin Institute of Industrial Biotechnology, CAS, Sichuan University, Sichuan Agricultural University and other scientific research institutes. The company's key technical personnel take synthetic biology research, fermentation production, separation and purification, analysis and testing as their specialties. Attaching great importance to the R&D investment, the company has completed the research and development of biosynthetic steviol glycosides (D&M), vanillin and psicose. Thanks to the rich experience in transformation of synthetic biology achievements accumulated during the industrialization of steviol glycosides, it has become one of the few companies in China that can conduct industrial R&D and production practice of synthetic biological technologies. Ingia-Bio has 19 authorized patents, including 4 foreign invention patents, 4 Chinese invention patents, and 11 utility model patents, with another 7 invention patents still in application.

盈嘉合生是中国首家天然产物合成生物学研发和生产制造公司，四川境内唯一一家开展天然产物合成生物学研究的科技型企业，从2018年开始连年入选科技部科技型中小企业库，2019年入选成都高新区瞪羚企业，2021年入选四川省"专精特新"科技型中小企业。公司2020年营收5600万元；2021年营收10200万元，持续保持高速增长。

Ingia-Bio is the first synthetic biology R&D and manufacturing company for natural products in China, and the only high-tech enterprise in Sichuan that conducts synthetic biology research on natural products. It has been selected into the pool of high-tech SMEs of the Ministry of Science and Technology since 2018, and was rated as a gazelle enterprise in CDHT in 2019 and a "Professional, Precise, Special and New" high-tech SME in Sichuan in 2021. The company yielded a revenue of RMB56 million in 2020, and RMB102 million in 2021, registering a continued rapid growth.

2022年2月14日已全部完成A轮融资，在资本的助力下，公司加速发展，2022年上半年会有3个产新品投放，同时将建成上海研发中心，2022年下半年将在成都天府国际生物城建成面积3000平方米的合成生物学技术平台并投入使用，盈嘉合生将成为合成生物学技术制造行业最重要的公司。目前有高瓴、弘晖、中金、华大等资本持续跟踪公司发展，今年四季度将完成A+或者B轮融资。

It completed the A series financing on February 14, 2022. Benefited from the capital, the company has accelerated its development. Scheduled to launch three new products and build the Shanghai R&D center in the first half of 2022, and construct and put into use a 3,000m2 synthetic biology technological platform in Chengdu Tianfu International Bio-town in the second half of 2022, Ingia-Bio vows to become the most important player in the synthetic biological manufacturing industry. At present, investors such as Hillhouse, Highlight Capital, CICC, and BGI are keeping an eye on the company's development. Ingia-Bio plans to complete the A+ or B series financing in the fourth quarter this year.

成都前沿医学中心二期

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