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Category

Best Biotechnology Product

General Information

Company Name *

MGI Tech

Product/Solution Name *

DNBSEQ-T20

Compound/Tech Name*

MGI Tech

Trade Name *

MGI Tech

Corporate Name *

Date of Approval *

2023-02-01

Indications *

In 2023, MGI Tech launched new revolutionary product DNBSEQ-T20 that can produce up to 50,000 WGS per year for under $100 per 30x human genome. DNBSEQ-T20 is the first and only one product in the world which drops genome sequencing price to sub $100, while the average in the field is still on $200 or more. In order to gather health data around the world, researchers needed a standardized collection process of clinic and hospital data and databases. However, large-scale whole genome sequencing technologies are difficult to carry out. Over the years, researchers have made great strides to drive the science forward. From higher throughput to greater data accuracy and efficiency, genomics companies nationwide have been working hard to push the boundaries of sequencing technologies. This also includes its pricing, which has dropped at a rate that outpaces Moore's Law, from $1 billion per human genome in 2007 to less than $100 this year.

The product is firstly enabled by DNA Nanoball Sequencing (DNBSEQ™) technology which fully owned by MGI Tech. An important distinction of the DNBSEQ technology is the PCR-free nature of the process. Secondly, it is enabled by innovative dip-immersion biochemistry, that makes the sequencing reagents recyclable and saves more than 60% cost. With the principle of two-color sequencing, it saves 50% of optical, computing, storage and broadband resources. That's why it can offer the sequencer at such a competitive price.

Using an open-type large sequencing slide cut from a whole silicon wafer, we make one DNBSEQ-T20 supporting the operation of 6 slides simultaneously. Enabled by innovative dip-immersion biochemistry, DNBSEQ-T20 perfects the unthinkable process for consecutive robotic dipping of multiple slides in the same reagent. Immersion fluidics on silicon slides without cover enables very uniform reaction over the entire surface of these large slides ensuring high sequencing quality, largest throughput and lowest cost.

1) Biochemical Module: The Key to Cost Reduction
The dip-immersion biochemistry technology applied to the biochemical module of T20 has improved the utilization rate of reagents and thus greatly reduced per-unit consumption, making sequencing more cost-efficient than ever. It is through dip-immersion biochemistry technology that T20 is able to strike the perfect balance between sequencing reading length, throughput, data quality, and cost.

The utilization of biochemical reaction in flow cell often found in traditional sequencers, entails a complex control system of fluid and temperature. This biochemical reaction that features "fixed samples but flowing reagents" highly depends on the flowing pipe's quality, including its flatness, temperature deformation, and high-precision fluid control. If the pipe fixed on the slide platform is not flat enough or is excessively deformed due to temperature change, the biochemical reaction may be incomplete and unsmooth, and the signal acquisition in the optical system will too be affected. The complex control system of fluid and temperature also means high hardware and maintenance costs. In addition, since the reagents in the continuous-flow biochemical reaction are non-reusable, the extremely low utilization rate also prevents cost reduction.

On the contrary, MGI's innovative dip-immersion biochemistry features "fixed reagents but transferable samples", which means that the coverless sequencing slides will be dipped consecutively in reagents for biochemical reactions, with temperature controlled precisely to 0.5 degrees Celsius to enable a uniform reaction. This helps solve the problem of uneven flow rate of reagents in traditional types, and free sequencing slides from surface bubbles. The biochemical reaction will be uniform and complete, with the utilization rate of the slide further improved. Besides, immersion fluidics on sequencing slides will ensure that the entire surface of these large slides is evenly heated, with little risk of deformation.

Enabled by innovative dip-immersion biochemistry, T20 perfects the unthinkable process for consecutive robotic dipping of multiple slides in the same reagent. With our self-developed reagent formula, we can reuse sequencing reagents without cross-contamination, thus ensuring the highest utilization rate, sequencing quality and efficiency, largest throughput, and lowest cost. This is where the biggest advantage lies.

2) Optical Module: The Cornerstone of T20 Ultra-high Throughput Signal Identification and Algorithm Output
The high-quality microscopic imaging system constitutes the core module of an ultra-high throughput sequencer. For its ultra-high throughput, T20 requires better optical imaging quality, precise image recognition, and faster data transmission. MGI's patented two-color fluorescence sequencing technology enables T20 to identify bases with high efficiency, greatly reducing the demand for optical hardware and computing resources, and also alleviating the pressure of big data transmission. This lays a solid technical foundation for the increase in sequencing throughput.

The optical module in T20 has a liquid immersion optical lens combined with TDI (time delay and integration) line scan cameras for ultra-high throughput signal acquire. It is reported that the T20 optical module consists of an optical imaging module and an optical control module. The former is used for capturing the fluorescence signal on the sequencing slide, while the latter controls the optical imaging module and generates the original base sequence into Cal. (Cal. is a binary file format generated by "basecall", a base recognition software in MGI sequencers).

It should be noted the multi-dimensional breakthroughs of T20 imaging system in the collection, transmission, and identification of high-throughput signals. The first is the liquid immersion optical lens in its imaging module, which is immersed in the reagent solution (as the imaging medium). Compared to the air medium, the lens in the solution provides a higher numerical aperture, which means better spatial resolution. Therefore, it supports higher DNA sample density on the sequencing slides, which increased data output per unit area. Furthermore, T20 is equipped with TDI, which is a method of line scanning which provides dramatically increased responsivity compared to other video scanning methods. The TDI line scanning camera in T20 improves optical image acquisition efficiency by 2-3 times with a high-performance motion platform. More importantly, the high-quality, domestic-made large-field of view (FOV) optical objective lens provides a single FOV of over 2mm diameter, which helps capture more fluorescence signals per unit time with higher signal-to-noise ratio, forming a strong foundation for increase in throughput and system improvement.

3) Sequencing Algorithm: The Basis for Super-large-scale Data Processing and Base Calling in T20
The large amount of fluorescence signals captured in unit time, which then have to be accurately and efficiently converted into the original base sequence information in real-time, poses a challenge to technical capabilities including real-time processing, signal conversion and data transmission. For improved data quality and minimized processing time, T20 is equipped with hardware acceleration technology, which overcomes the limit of traditional CPU architecture on computing capability and I/O capability, and improves data processing capacity by more than one hundred times.

T20 R&D team proposed an asymmetric algorithm for asymmetric extracting the brightness of point light sources to support TDI line scan imaging. In tandem with the sequencing process, the algorithm will make dynamic adjustments in light of real-time parameters and significantly improve accuracy. At the same time, the integration of traditional image processing methods and deep neural network methods will also increase accuracy and applicability of the base calling algorithm.

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Therapeutic Areas *

Cheaper genome sequencing makes essential genetic screening tests available to lower (economical) class of population. These tests provide important information about genetic carrier status of people, and so their children's genetic risks. It is possible to decrease the frequency of genetic diseases with genetic screening and counselling.

In today's world where an estimated 44% of adults are struggling to pay for healthcare, cheaper genome sequencing will make deeper genome understanding and essential genetic screening tests accessible to more people, especially those with a low socio-economic status. With more accurate

diagnoses and more individualized treatments enabled by fordable AI tools trained on these data-rich DNA sequencing tests, precision medicine powered by genome sequencing to find inherited predispositions and to monitor molecular health of our tissues can significantly reduce the financial burden of patients and economy.

Lower sequencing costs are the key to enabling rapid and widespread adoption of precision medicine. With lower costs come lower barriers for clinicians to incorporate genetic testing into routine patient care. Earlier and more accurate diagnoses, as well as more personalized treatment plans, lead to potentially better treatment outcomes and quality of life for patients with rare genetic disorders, many of whom have historically faced a lengthy and often frustrating diagnostic odyssey. Furthermore, for health monitoring and disease prevention we need automate sample-to-sequence highly efficient and accurate large-scale DNA sequencing labs.

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Attached Files:

- GenomeWeb_Complete Genomics Unveils New Platform for UltraHighThroughput Sequencing Market.pdf
- BioWorld_Complete Genomics sequencer reads human genome for under 100.pdf
- STAT_Complete Genomics looks to rival Illumina with new sequencer_2 7 20231.pdf
- _20230203194814.jpg

Background information and need for drug / device
(please be as specific as possible in your description; limit 500 words)

In order to gather health data around the world, researchers needed a standardized collection process of clinic and hospital data and databases. However, large-scale whole genome sequencing technologies are difficult to carry out. Over the years, researchers have made great strides to drive the science forward. From higher throughput to greater data accuracy and efficiency, genomics companies nationwide have been working hard to push the boundaries of sequencing technologies. This also includes its pricing, which has dropped at a rate that outpaces Moore's Law, from $1 billion per human genome in 2007 to less than $100 this year.

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History of the development of the solution/product *
(please be as specific as possible in your description; 500 words)

MGI's R&D team started developed the product in 2022.

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Why this drug or device is innovative, the broad implications for future research, and/or how it will improve the human condition *

It for the first time in the industry drops genome sequencing price to sub $100, while the average in the field is still on $200. Why is the price of sequencing so important? Sometimes the barrier to medical advancement isn't in the science. It's the money! The lower sequencing will benefit precision medicine and precision treatment. Because with affordable cost of sequencing, many new clinical applications (for example genetic testing, genetic diagnosis, and gene therapy) will be open, and the goal of improving human health through genomics research will also being realized. Then it will effectively help clinical disease diagnosis and treatment, the development of precision medicine, the sequencing-based health monitoring and disease prevention.

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Please provide appropriate references (PubMed, Abstract, Website) *

https://en.mgi-tech.com/products/instruments_info/33/

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