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Licensing Opportunity

TTO – Technology Transfer Office

Digital information decoding and data storage in hybrid macromolecules

Figure 1: Engineered bacterial pores can decode digital information stored in tailored-made polymers.

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Description

Semiconductor chips and magnetic field tapes have tremendously improved the data storage capacity in silicon devices. However, these devices start deteriorating after about two decades. Also, data centers produce enormous carbon footprints. The exponential growth in demand for digital data production and storage cannot be sustained by current technology.

Here proposed, an alternative support for data storage aiming at higher density and longer-term storage made of informational heteropolymers that are decoded by a bacterial nanopore (aerolysin) platform.

The molecular medium encodes information in a bitstream-format. Sequence-controlled DNA-polymer hybrid structures are used to encode individual binary information. Decoding is done by biological nanopores based on engineered pore-forming toxin aerolysin. By a rational and synergic development of aerolysin mutants and the design of DNA nucleobases intercalated on sequence-encoded heteropolymers, the translocation speed of the hybrid molecule can be optimized to have a uniquely identifiable signal, which delivers digital reading with single-bit resolution without compromising information density.

Advantages

- Bio-inspired platform for encoding and decoding informational polymers.
- Nanopore reding of hybrid macromolecules is optimized to have a uniquely identifiable signal that delivers single bit resolution.
- Biological nanopore sensing relies on electrical readout and enables construction of more affordable and portable devices for data management.
- No additional labelling is required for nanopore sensing.
- The information density of existing DNA-based solutions can be enhanced for long-term storage.
- Lower costs (and time) for sample preparation as amplification is no longer required. The amplification errors are also eliminated.
- Decoding is a non-destructive process.
- Deep learning supports decoding of digital information.

Applications

- This bio-inspired platform opens promising perspectives for addressing problems including ultrahigh density data storage, long-term archival, anticounterfeiting systems, and molecular cryptography.