Opportunity Title: Solid State Nanopore Polymer Sequencing for Information Storage Applications
Opportunity Reference Code: ICPD-2021-15

ORISE

Organization Office of the Director of National Intelligence (ODNI)

Reference Code ICPD-2021-15

How to Apply

Create and release your Profile on Zintellect – Postdoctoral applicants must create an account and complete a profile in the on-line application system. **Please note: your resume/CV may not exceed 2 pages.**

Complete your application – Enter the rest of the information required for the IC Postdoc Program Research Opportunity. The application itself contains detailed instructions for each one of these components: availability, citizenship, transcripts, dissertation abstract, publication and presentation plan, and information about your Research Advisor co-applicant.

Additional information about the IC Postdoctoral Research Fellowship Program is available on the program website located at: https://orise.orau.gov/icpostdoc/index.html.

If you have questions, send an email to ICPostdoc@orau.org. Please include the reference code for this opportunity in your email.

Application Deadline 2/26/2021 6:00:00 PM Eastern Time Zone

Description

Research Topic Description, including Problem Statement:

There is a growing gap between information production and the ability to store data, which traditional storage media are unable to bridge. Sequence-controlled polymers are an attractive solution because they provide orders-of-magnitude improvements in data density and the energy cost at rest, but they provide limited read modality solutions that can compete on relevant performance metrics, especially accuracy, throughput, and cost. Although synthetic polymers have advantages over biological polymers in terms of cost of synthesis and durability, most of the work in this field has centered on DNA-based polymers because highly scalable and accurate read modalities are limited to DNA sequencers that employ DNA specific chemistries (e.g., sequencing by synthesis, biological nanopores).There is a need to develop alternative sequencing solutions that are polymer agnostic and deliver application relevant accuracy, throughput, and cost. Recent demonstrations of synthetic polymer-based information storage have employed polymers analogous to DNA, where information is encoded at the monomer level. Read modalities with sufficient accuracy to read data encoded in this fashion are limited to expensive, low throughput instrumentation (i.e., mass spectroscopy).Biological nanopores have shown the ability to accurately discriminate between blocks of individual copolymers (both DNA and synthetic polymers), but these systems rely on lipid (or lipid-like) membranes to immobilize the pore, which are limited by both the relative fragility of the membrane and the variation in biological pore immobilization (i.e., Poisson distribution).Solid-state nanopores have been shown to overcome these limitations as the inorganic materials used to form the membrane are highly resilient and fabrication techniques ensure each membrane has a single aperture. Given these advantages, there is a need to develop solid-state nanopore fabrication techniques that not only result in nanopores capable of distinguishing between information-encoding units with high accuracy, but that also exhibit resilient durability while being compatible with multiplexed, high-throughput sequencing instrumentation, ideally CMOS (complementary metal–oxide–semiconductor) based. This research topic will investigate novel approaches to fabricating solid-state nanopores that offer compelling solutions to issues associated with accuracy, throughput, cost, and durability.

Example Approaches:

- 10.1038/s41578-020-0229-6: Recent and comprehensive solid-state nanopore review article.
- 10.1021/acsnano.5b02369: Direct and scalable fabrication of nanopores in 2D membranes.
- 10.1038/nnano.2016.153: Direct observation of high-order DNA nanostructures with solid-state nanopores.
- 10.1038/nnano.2015.219: Differentiation of 30-mer polynucleotides homopolymers with a solid-state nanopore in a 2D membrane.
- 10.1021/acsnano.9b04626: Integrating low-noise glass nanopores with CMOS for multiplexed, high-bandwidth recordings.
- 10.1038/s41467-018-07116-x: Solid state-biological nanopore hybrids, possibly the best of both worlds.
- 10.1002/smtd.201900595: Open challenges in protein sequencing using bio-nanopores.

Relevance to the Intelligence Community:

First generation Molecular Information Storage (MIST) technology will set the Intelligence Community (IC) on a path toward continuous exponential improvements in storage capacity, saving billions of dollars in future costs while expanding a key resource to support the IC's national security mission.

Key Words: Single Molecule Detection, Multiplexed Detection, Nanopore, Biosensors, Multiblock Copolymers, Information Storage, Information-Containing Macromolecules

Qualifications

Postdoc Eligibility

- U.S. citizens only
- Ph.D. in a relevant field must be completed before beginning the appointment and within five years of the application deadline
- Proposal must be associated with an accredited U.S. university, college, or U.S. government laboratory
- Eligible candidates may only receive one award from the IC Postdoctoral Research Fellowship Program

Research Advisor Eligibility

- Must be an employee of an accredited U.S. university, college or U.S. government laboratory
- Are not required to be U.S. citizens

Eligibility Requirements

- **Citizenship:** U.S. Citizen Only
- **Degree:** Doctoral Degree.
- **Discipline(s):**
  - **Communications and Graphics Design** (2)
  - **Computer, Information, and Data Sciences** (17)
  - **Earth and Geosciences** (21)
  - **Engineering** (27)
  - **Environmental and Marine Sciences** (14)
  - **Life Health and Medical Sciences** (45)
  - **Mathematics and Statistics** (10)
  - **Other Non-S&E** (2)
  - **Other Physical Sciences** (12)
  - **Other S&E-Related** (1)
  - **Physics** (16)
  - **Social and Behavioral Sciences** (27)