Opportunity Title: Advanced battery development
Opportunity Reference Code: IC-18-20

Organization	Office of the Director of National Intelligence (ODNI)
Reference Code	IC-18-20
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://orau.org/icpostdoc/. If you have questions, send an email to ICPostdoc@orau.org. Please include the reference code for this opportunity in your email.
Application Deadline	3/12/2018 11:59:00 PM Eastern Time Zone
Description	**Research Topic Description, including Problem Statement:** • The objectives of this project are to develop advanced Lithium-ion (Li-ion) batteries with both high cycling and energy storage capacity and to develop electrolyte formulations to enhance battery cycle life, wide temperature performance, and safety. • The goal is batteries with at least three to four times the state-of-the-art Li-ion capacity (1,350 – 1,800 mAh/g) combined with both long cycle life performance on the order of 100,000 cycles and safe operation. The extraordinary properties of nanotechnology have prompted research into advanced anodes and cathodes that can survive high depths of discharge while retaining cycle lifetimes applicable to the most challenging orbital environments. Carbon nanotubes (CNTs), a specific nanotechnology implementation, have demonstrated the ability to increase power densities while reducing battery mass. The replacement of bulk carbons and graphites allow for more robust anode architecture while maintaining cycle life and energy density. The addition of materials such as silicon and germanium, which both have high theoretical energy density efficiencies, allow for a battery energy density approaching two times today's space standard Li-ion cell. The largest challenge with these advanced anodes is the

large volume increase resulting in the loss of conduction with the current collector and therefore a decrease in cycle lifetime. Through the incorporation of CNTs, these anodes may retain their conductive connection and retain their cycle lifetimes.

- Advances in cathode development have also allowed for high energy densities and higher depth of discharge than regularly available for space batteries. Advanced nanostructured spinels and phospho-olivine structures have stable, yet high energy density states over current cathodes. The largest challenge with these architectures is the ability to increase their cycle lives to that necessary for LEO and GEO applications. The addition of CNTs within these advanced cathode architectures has demonstrated the ability to increase power densities while maintaining cycle lifetimes. Further refinement of these nanostructures may demonstrate further improvements in power density, energy density, and cycle lifetime. Removing copper from the system not only reduces the system weight but also removes the minimum voltage limit on the battery. The performance of the developed batteries can be demonstrated by constructing, testing, and delivering pouch cells.
- The electrolyte formulations for these batteries are expected to improve operational, storage, and performance efficiencies at wider temperature ranges. Further electrolyte work could include formulations specifically to address different positive and negative materials (e.g., LTO, NCA, Si-C composites, etc.), gas reduction at higher (>4.2V) and near zero voltages, and performances at wider temperature ranges (to include -50 to +60C).

Example Approaches:

- Fabrication of carbon and silicon anodes matched with lithium sulfur cathodes or comparable high performance anodes and cathodes.
- Fabrication and test of representative lithium-ion cells as well as feasibility studies for integration into system with cycle lifetimes representative of LEO and GEO orbits.
- Identification of carbon nanotube electrode architectures appropriate for full battery integration.
- Assessment of battery energy density using CNTs as conductive additives, current collectors, and active materials.

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

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- 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):**
  - **Chemistry and Materials Sciences** (12 👁)
  - **Communications and Graphics Design** (6 👁)
  - **Computer, Information, and Data Sciences** (16 👁)
  - **Earth and Geosciences** (21 👁)
  - **Engineering** (27 👁)
  - **Environmental and Marine Sciences** (14 👁)
  - **Life Health and Medical Sciences** (45 👁)
  - **Mathematics and Statistics** (10 👁)
  - **Other Non-Science & Engineering** (5 👁)
  - **Physics** (16 👁)
  - **Science & Engineering-related** (1 👁)
  - **Social and Behavioral Sciences** (28 👁)