Opportunity Title: Advanced Materials for Light Weight Zero Volt Batteries
Opportunity Reference Code: IC-17-18

Organization	Office of the Director of National Intelligence (ODNI)
Reference Code	IC-17-18
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.
Application Deadline	3/31/2017 11:59:00 PM Eastern Time Zone
Description	**Unclassified Research Topic Description, including Problem Statement**: 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 (CNT), a specific nanotechnology implementation, have demonstrated the ability to increase power densities while reducing battery mass. The complete replacement of bulk carbons and graphites with CNT allows for a 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 has 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 Low Earth Orbit (LEO) and Geostationary Orbit (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 lightweights the system but also removes the minimum voltage limit on the battery.

Note: *Zero volt batteries are batteries that can be stored at 0 (zero) voltage. This is important in situations such as satellites, in order to enhance safety of the satellite system as it is being stored prior to launch.*

Example Approaches:

Example approaches could include:

- 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.

Eligibility Requirements

- **Citizenship:** U.S. Citizen Only
- **Degree:** Doctoral Degree.
- **Discipline(s):**
  - **Business** (11 👁)
  - **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** (13 👁)
  - **Physics** (16 👁)
  - **Science & Engineering-related** (1 👁)
  - **Social and Behavioral Sciences** (28 👁)