Opportunity Title: Propagation-Resistant Safe Battery Packs Without Compromising on High Energy Densities
Opportunity Reference Code: ICPD-2020-12

Organization Office of the Director of National Intelligence (ODNI)

Reference Code ICPD-2020-12

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 2/28/2020 6:00:00 PM Eastern Time Zone

Description **Research Topic Description, including Problem Statement:**

Li-ion batteries have become indispensable in modern life and have enabled a plethora of portable devices such as cell phones and drones due to their high energy density. Li-ion batteries are poised to revolutionize the transportation sector with major automakers announcing a complete switch from internal combustion engines to battery electric vehicles (BEV), as such the BEV market share is projected to be about 20% of all new car sales globally by 2030[1].

Due to the increased run-time or reduction in size/weight, the military and Intelligence Community (IC) have also become reliant on high-energy Li-ion batteries to power their equipment. However, there is a safety drawback with Li-ion batteries. The energetic lithiated anode and the highly flammable organic electrolyte typically present in Li-ion batteries have resulted in several safety incidents, such as BEV fires reported to occur spontaneously[1], overheating of the Boeing 787 Dreamliner auxiliary power unit battery[2] and a battery fire within the Navy's Advanced SEAL Delivery Vehicle (ASDS)[3].

Due to the requirement to increase safety of large battery packs with multiple cells in series and parallel, typical battery packs in BEVs may exhibit energy densities of only ~120 Wh/kg and ~200 Wh/L, whereas Li-ion on the cell level can exhibit up to ~250 Wh/kg and ~650 Wh/L.

The large reductions in energy densities are in part a result of increasing safety. However, an individual cell can still fail in an unsafe manner, this has to be managed to prevent propagation throughout an entire battery pack. Notable work to develop propagation-resistant batteries was done by NASA. NASA found that in 18650 cells there was a high propensity to side wall ruptures. To prevent propagation of failure, a pack design included increased cell spacing, interstitial heat sinks, individual cell fusing and flame arresting vent ports, which impacts size and weight[4].

The aim of this topic is to develop fundamental understanding of the materials and cell parameters that affects a passive propagation-resistant battery pack in order to realize energy densities close to the cell level but retain the safety features shown in the NASA propagation-resistant battery pack.

Example Approaches:

Opportunity Title: Propagation-Resistant Safe Battery Packs Without Compromising on High Energy Densities
Opportunity Reference Code: ICPD-2020-12

- Investigate the limitations of building block cells at close proximity. For example, is it safer to use 20Ah cell vs. a 2Ah building-block cell for a kWh battery?
- Further understanding of resistance to propagation vs. building-block cell design (e.g. high power vs. high-energy cell).
- Model pack energy density as a function of parameters such as cell energy density, cell spacing, cell construction (prismatic vs. cylindrical), phase change materials etc.
- Validate models using small representative battery packs.

Relevance to the Intelligence Community:

In many applications the IC users require large battery packs, be that for drones, military applications, intermittent mains power, and extended run time for existing devices. Safety in any large system is always paramount. If this project is successful, the understanding can contribute to developing and building a passive propagation-resistant Li-ion battery pack exhibiting 200-250 Wh/kg and 400-500 Wh/L.

References:

1. Wu, H., Alberts, G., Hooper, J., & Walton, B. (2019, January 31). Battery Electric Vehicles New markets. New entrants. New challenges. Retrieved from http://www2.deloitte.com/uk/en/pages/manufacturing/articles/battery-electric-vehicles.html
2. O'Kane, S. (2019, May 16). Tesla pushes battery software update after recent fires. Retrieved from http://www.theverge.com/2019/5/16/18627746/tesla-fire-battery-software-update-model-s-x
3. Mouawad, J. (2014, December 1). Report on Boeing 787 Dreamliner Battery Flaws Finds Lapses at Multiple Points. Retrieved from https://www.nytimes.com/2014/12/02/business/report-on-boeing-787-dreamliner-batteries-assigns-some-blame-for-flaws.html
4. Darst, J., Thomas, J. C., Finegan, D. P., & Darcy, E. (2018, June 11). Guidelines for Safe, High Performing Li-Ion Battery Designs for Manned Vehicles. Retrieved from https://ntrs.nasa.gov/search.jsp?R=20180003971

Key Words: Batteries, Battery Packs, Lithium, Li-ion, Safe, Propagation Resistant, Passive, Energy, Density

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.

zintellect
climb higher

Opportunity Title: Propagation-Resistant Safe Battery Packs Without Compromising on High Energy Densities
Opportunity Reference Code: ICPD-2020-12

- **Discipline(s):**
  - **Chemistry and Materials Sciences** (12 👁)
  - **Communications and Graphics Design** (2 👁)
  - **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** (2 👁)
  - **Physics** (16 👁)
  - **Science & Engineering-related** (1 👁)
  - **Social and Behavioral Sciences** (27 👁)