RQ15-25

1. **Research Title:** *High Capacity, Advanced Battery Development*

2. **Individual Sponsor:** Dr. Ryan M. Miller
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3. **Academic Area/Field and Education Level:** Chemical and Materials Engineering / electrochemistry, catalysis, ceramic processing, high-temperature materials, modeling/simulation (MS or Ph.D. level)

4. **Objectives:** Next generation aircraft contain a host of system-level power and thermal challenges to enable capabilities such as: low-observable electronic attack and electrically-driven directed energy-based self-defense. Energy storage is among the critical technology challenges supporting aircraft power and directed energy weapons (DEWs). To this end, AFRL has the goal to develop a high capacity, advanced battery capable of operation as both an abuse tolerant, high-rate power dense source while maintaining high energy storage capability safely across a wide-temperature range. Current efforts focus on work, ranging from: the development of high capacity cathode materials for solid-state Li batteries; novel film processing techniques for the fabrication of solid-state batteries and fuel cells; power management/hybridization technology for small unmanned aerial vehicles (S-UAVs) and portable soldier power; and aircraft/DEW battery characterization and analysis.

5. **Description:** The goal of this 3-year DAGSI project is to investigate methods for developing high capacity, advanced batteries for traditional aircraft and S-UAV applications. Solid-state lithium batteries have gained considerable interest as a next generation high energy-dense electrochemical power source. They offer not only the potential for high energy densities but also safe operation as compared to state-of-the-art Li-ion battery technology. In practice, the performance of these batteries falls drastically short of the potential theoretical values due to limitations in cathode diffusion/reaction kinetics and instability/decreased conductivity issues in the electrolyte. Advancing beyond these limitations is a function of two important but equal aspects: development of high capacity, safe cathode materials and introduction of novel cell processing techniques. DAGSI researchers will assist AFRL in exploring alternative novel cathode materials and utilizing advanced film processing techniques (ink jet and aerosol jet printing) to fabricate all solid-state cell configurations. In addition, energy and power densities in batteries typically have an inverse relationship, making it unlikely that one battery can provide both. Therefore, there is an interest for DAGSI researchers to work with AFRL to look at hybridizing different battery chemistries to produce an overall hybrid battery pack which can provide both high power discharge capability while maintaining high energy density storage.

6. **Research Classification/Restrictions: Unclassified /** U.S. Citizens only.

7. **Interest in Summer USAFA Cadet: NO**

8. **Eligible Research Institutions:**

[X] Universities (DAGSI) [X] AFIT [ ] USAFA

Public Release Pending