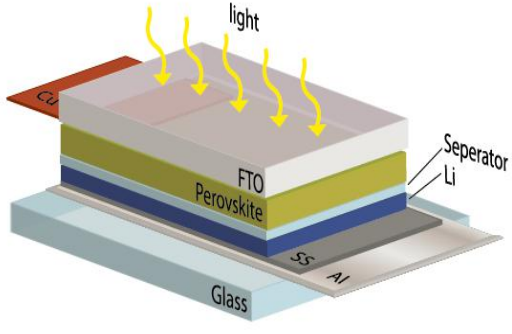
Title: Photo-Rechargeable Organo-Halide Perovskite- Transition Metal Dichalcogenide Batteries.

Funding Agency: Science and Engineering Research Board (SERB)- ECRA (Early Career Research Award)
Completion Date: Dec 2022
Project PI: Dr. Shahab Ahmad

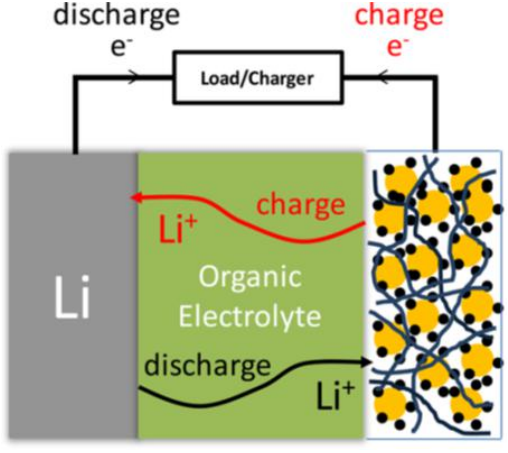
Brief Description: Solar cells are one of the most promising renewable energy devices since they convert sunlight directly into electricity. However, energy harvested by the solar cells needs to be stored by devices such as batteries to power-up the appliance. Both energy harvesting, conversion and storage require two different type of mechanism and hence technologies. The merger of above two functionalities in a single device would significantly improve the volumetric performance, will provide more compact energy solutions for mobility, standalone electronics, reduced cost of fabrication etc. However this is challenging because of material and manufacturing, and compatibilities between energy harvesting and storage materials. In this project we want to focus on special nanomaterials which are capable of harvesting sunlight, like a solar cell and store energy, like a Li-ion battery simultaneously, this device is termed as Photo-Battery.



Title: Sulphur nanoparticles Reinforced Hierarchical Assemblies of Carbon nanotubes for Efficient Lithium-Sulphur Batteries.

Funding Agency: Department of Science and Technology (DST)
Completion Date: Nov 2022
Project PI: Dr. Shahab Ahmad

Brief Description: Sulphur is one of the most abundant elements in earth's crust, offers a high theoretical capacity of 1672 mAh/g, which is several times higher than that of the commercial lithium-ion batteries (graphite ~372 mAh/g). The Li-S battery technology have suffered from several challenges associated with sulphur cathode such as poor long-term performance and low Coulombic efficiency, which may prevent their practical applications. These problems are mainly related to poor electronic conductivity of solid sulphur species (S, Li_2S_2, and Li_2S), significant volumetric changes (~ 80%) upon the formation of Li_2S and dissolution of polysulfides into the organic electrolyte, which leads to the shuttle effect. To address the above mentioned challenged, we propose the use of hierarchical assemblies of carbon nanomaterials where sulphur can be reinforced which will help in enhancing the conductivity of S electrode to provide smooth transport to the charges in Li-S batteries.



Title: Photo-Rechargeable Perovskite Batteries for Future Mobility.

Funding Agency: Department of Science and Technology (DST)- UK-India Education Research Initiative (UKIERI) International Research Project
Completion Date: July 2022
Project PI: Dr. Shahab Ahmad

Brief Description: The project objective involve the Optical, Structural, Optoelectronic and Morphological characterizations of thin and thick films of low-dimensional perovskites, as well as electrochemical characterizations of perovskites electrodes in standard coin-cell configurations. This will help in optimizing high quality perovskites for photo-battery applications. Further perovskite photo-batteries will be fabricated and their electrochemical characterizations will be studied for high capacity and high performance photo-batteries to establish the relationship between the opto-structural and electrochemical properties of these novel nanomaterials.