

The Department of Mechanical Engineering presents:

The Ph.D. Dissertation Defense of Alejandro J. Alvarez Barragan

**Thursday, May 30, 2019,
3:30PM in Bourns Hall A265**

Nanomaterials for Energy Applications: From Photovoltaics to Plasmonic Catalysis

Doctor of Philosophy, Graduate Program in Mechanical Engineering
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Dr. Lorenzo Mangolini, Chairperson

Energy applications are essential for the development of technologies capable of confronting the challenges inherent to a growing global population. Among the different renewable energies, the solar resource has advanced as the most promising due to its omnipresence in Earth life. This work investigates the synthesis and properties of three materials with the potential to contribute to the utilization and storage of solar energy. In detail, this dissertation addresses the feasibility of $\text{Cu}_2\text{ZnSnS}_4$ (CZTS) as a novel thin film photovoltaic material by studying the role of process parameters, phase segregation, and grain-to-grain homogeneity of CZTS thin films. It also studies the stability of silicon-carbon heterostructures for lithium-ion batteries and introduces a non-thermal plasma/CVD system that offers good control on particle size and composition. Finally, this work presents a comprehensive investigation of plasmonic titanium nitride nanoparticles synthesized with a non-thermal plasma method. It demonstrates their potential as photocatalysts and photothermal absorbers with good stability and resistance to high temperatures as compared to conventional plasmonic materials based on costly noble metals.