DREXEL UNIVERSITY
Materials Science and Engineering
College of Engineering

Department of Materials Science and Engineering,

PhD Proposal Exam

May 5th, 2023, 1:00 PM
Zoom: https://drexel.zoom.us/j/86851792649

Aqueous Stabilization and Functionalization of Organohalide Perovskite Nanocrystals by Multilayered Surface Modifications as Molecular Probes for Bioimaging Applications

Name: Ozgun Acar
Advisor: Dr. Wei-Heng Shih
Co-Advisor: Dr. Wan Shih

Abstract

Organohalide perovskite nanocrystals (OHPNCs) are semiconductor nanoparticles with ABX_3 structure. They are of great interest due to their promising electronic and optical properties and have been studied for applications such as solar cells and light-emitting diodes (LEDs). However, one obstacle against their commercialization in solar cells and LEDs is their lack of stability against environmental factors such as moisture, heat, and light. Meanwhile, another potential application of OHPNCs is molecular probe to image biological cells or molecules due to their outstanding photoluminescence (PL) intensity. Here the further challenge is to stabilize OHPNCs in aqueous environment. In this work, we took a multilayer coating approach to modify the surface of methylammonium lead bromide ($MAPbBr_3$) OHPNCs to protect and functionalize the OHPNCs to allow conjugation of antibodies to create OHPNC molecular probes for bioimaging. First, stearic acid (SA) was used as a surface ligand replacing commonly used oleic acid (OA) because of higher melting point which is expected to have a stronger binding to OHPNC surface increasing stability. Second, tetraethyl orthosilicate (TEOS) was used to create a silica shell on clusters of OHPNCs for increased protection in toluene containing 1% water. Third, to provide better protection in a complete water environment, Pluronic F127 triblock copolymer together with a non-ionic surfactant Kolliphor HS 15 was introduced. Once the OHPNCs were stabilized by the multilayer approach, F127 was carboxylated using carbonyldiimidazole (CDI) chemistry together with diglycolic acid (DGA). In future work, 1-(3-dimethylaminopropyl)-3-ethylcarbodiimide (EDC)/N-hydroxysuccinimide (NHS) coupling will be used to conjugate carboxylated OHPNCs with amine groups on antibodies forming molecular probes for specific staining of cancer cells.