CHEMISTRY COLLOQUIUM

Synthesizing Nanoparticles for Green Energy: New chemistry from the surface to the core

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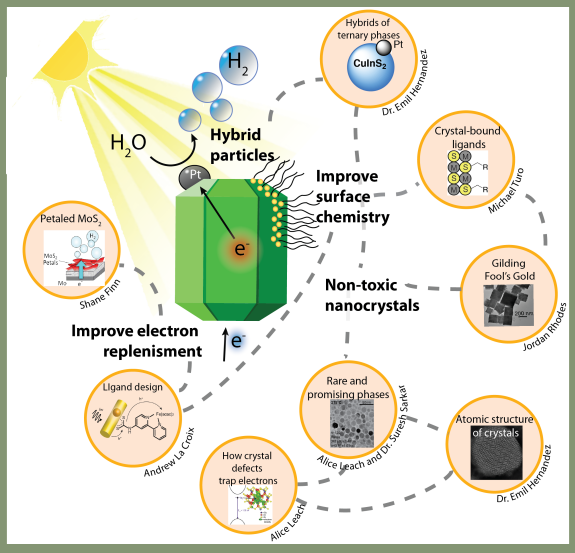

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Abstract:
Since our community began focusing on the "bottom-up" synthesis of nanoparticles and nanomaterials, our synthetic control has developed from control of the size of spherical, single component nanoparticles, to materials of increasing compositional complexity and structural design. These added design components lead to heightened functionality. In the Macdonald research laboratory, we strive towards new nanocrystal chemistries that will facilitate goals in green energy applications such as photocatalytic water splitting and photovoltaics.
Our chemical journey has caused us to make fundamental discoveries about surface chemistry, crystalline order and reactivity. Our efforts have focused lately on a new binding mode of thiols on nanoparticle surfaces, that makes particles less prone to oxidation or ligand loss, and improves charge transfer in photocatalytic reactions. In a second project, we study the formation mechanism, the NIR luminescence and its origin in wurtzite $CuInS_2$, a form only found in nanocrystals. Along the way we discovered an unreported type of crystalline order in mixed cation sulfides such as $CuInS_2$ with sweeping implications for opto-electronic and thermo-electronic properties for these materials. In the last project presented here, we have developed petaled nanostructured cathodes of MoS_2 that outperform Pt in Quantum Dot Sensitized Solar Cells.