Student Seminar Series

9:45 a.m. Tuesday, February 5, 2013 • 331 Smith Hall

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Earth Abundant Element Solar Cells from Nanocrystal-Inks and Molecular-Inks

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http://www.cheme.washington.edu/facresearch/faculty/hillhouse.html

Abstract
Given the terawatt scale of future energy needs, the most promising future photovoltaic materials should be Earth abundant with their primary mineral resources distributed across several geographic regions and their supply chains robust to reduce concerns of price volatility. In addition, the process of forming the solar cell should be scalable, low-cost, and not utilize dangerous or toxic materials. The strongest initial candidate appears to be kesterite structures of Cu₂ZnSnS₄ (CZTS) and similar materials. The presentation will review the progress in developing photovoltaics devices based on these materials and our group’s recent experimental and modeling results. CZTS thin film solar cells have historically been synthesized by evaporating or sputtering metals (Cu, Zn, & Sn) followed by sulfurization or selenization. More recently, two potentially low-cost high-throughput approaches have been demonstrated that form the quaternary or pentenary chalcogenide directly from solution-phase processes. One is based on first synthesizing multinary sulfide nanocrystals and then sintering them to form a dense layer. The other approach utilizes molecular precursors dissolved in hydrazine. Both new approaches reach their highest device efficiencies by incorporating Se to form Cu₂ZnSn(Sₓ,Se₁₋ₓ)₄, devices, and each has yielded substantially higher efficiency devices than the best vacuum deposited absorbers. The hydrazine route has yielded the most efficient CZTS-based devices thus far. The presentation will highlight our recent progress in CZTS-based solar cells from nanocrystal-inks and new non-hydrazine molecular-inks developed in our lab.

Host:
T. Ryan Knutson