

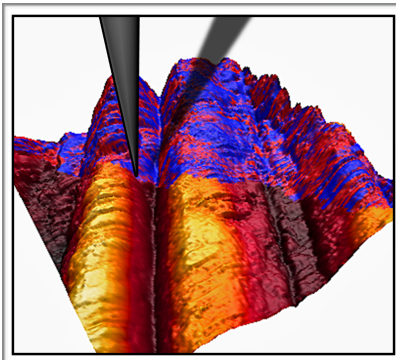


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A Microscopic Understanding of Solar Cell Materials Using Scanning Tunneling Microscopy

In the face of the world energy crisis and climate change, solar energy is the leading potential resource that can ensure a sustainable energy source free from carbon emission which is also capable of being produced for generations to come. Among the next generation solar cells, organo-metallic mixed halide perovskite solar cells (OMHPSCs) and quantum dot sensitized solar cells (QDSSCs) show promises towards this goal. OMHPSCs have recently drawn plenty of attention due to their low cost and extraordinary power conversion efficiency performance. The efficiency of the solar cells using Pb-based perovskites increased from ~3 % in 2009 to ~21 % in 2016. On the other side, the efficiency of quantum dot sensitized solar cells has increased more slowly, 10.6%, on roughly the same time scale. Many different techniques have been used to improve device performance and overall efficiency. One way to improve the efficiency is to tailor the band-gap of the device materials to be most suitable for charge separation and conduction. There exist many ways to tailor a material's band-gap: one example is changing the stoichiometric ratio of the halides in an OMHP, another example is introducing dopants, more specifically Mn dopants in semiconducting QDs. Understanding how the stoichiometry of a solar cell material or how a dopant influences the band structure are a couple paths toward better band-gap tailoring and thus achieving higher efficiency photovoltaics. In this seminar we will look at how scanning tunneling microscopy is utilized in conjunction with a suite of other characterization tools to study the microscopic electronic band structure in an OMHP and in several Mn doped QD systems.



Andrew J. Yost is a Ph.D. candidate in the Department of Physics and Astronomy at the University of Wyoming. Presently Andrew is a NASA Space Grant graduate research fellow and the assistant editor for Emerging Science Journals, Flexible Electronics. During his Ph.D. candidacy Andrew received the National Science Foundation GK-12 Energy and Environmental Nanotechnology graduate research fellowship from 2013-2016 and was given the opportunity to do a research internship at Argonne National Laboratory in the summer of 2013. In 2014 Andrew was inducted into the Phi Kappa Phi honor society and has been the recipient of numerous graduate student travel awards and mentorships. Andrew's research is focused on the investigation of the spatial evolution of the electronic properties, specifically the energy band alignment, across interfaces of semiconductor and nanostructured systems and the influence of magnetic dopants on the evolution of the band structure of semiconductors. His research includes studies pertaining to organic molecules on graphene, novel graphene fabrication techniques, growth of CuO nanowires and applications in solar cells, modified carbon nanotubes for use in oxygen reduction reactions, quantum dot sensitized solar cells, and perovskite structured semiconductors and their applications in solar cell devices.

Host:
Professor Peter
Dowben

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