MATERIALS ENGINEERING

SEMINAR

"Alkali Treatments for Solution Processed Cu(In, Ga)(S, Se)$_2$ Films and Photovoltaic Devices"

By

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ABSTRACT

The world is increasingly in need of renewable energy sources that can be deployed on a large scale. Cu(In, Ga)(S, Se)$_2$ (CIGSe) solar photovoltaic devices are highly efficient when fabricated through vacuum processes, especially with recent developments in heavy alkali (K, Rb, Cs) post-deposition treatments pushing record efficiency up to 23.35%. Solution processes such as nanoparticles and molecular precursors have the potential to produce the same material through more scalable and less costly methods, but record efficiency for these devices lags behind at 18.3%. Heavy alkali post deposition treatments increase band gap and copper depletion at the surface of p-type CIGSe, allowing for a better interface with the n-type CdS buffer layer. This study aims to understand the mechanisms by which heavy alkalis improve vacuum processed CIGSe device efficiency in order to use heavy alkali treatments on solution processed CIGSe films. This involves studying proposed theoretical reasons for experimentally measured optoelectronic property improvement in order to predict which changes will also occur in solution processed CIGSe, and utilize these treatments for higher efficiency devices. This also requires understanding the differences in phase transformations and grain sintering behavior between the same material when it is made through vacuum and solution processes. Heavy alkali post deposition treatments for solution processed CIGS are of particular interest, as this may positively affect the electrical properties with fewer changes in the film microstructure. This study aims to predict how to best design these treatments, then identify changes in material properties that will lead to high efficiency devices. Careful examination of nano/microscale material properties is necessary in order to holistically understand changes in device efficiency as well as the mechanisms that lead to these changes.

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