New Horizons in Coatings and Thin Films
Room Royal Palm 1-3 - Session F1-2

Nanomaterials and Nanofabrication
Moderators: R. Mohan Sankaran, Case Western Reserve University, Sumit Agarwal, Colorado School of Mines

1:30pm **F1-2-1 Accelerated Development of CuSb(S, Se)$_2$ Thin Film Photovoltaic Device Prototypes**, *Colin Wolden,* Colorado School of Mines, USA   **INVITED**
Development of alternative thin film photovoltaic technologies is an important research topic due to the potential of low-cost, high-efficiency solar cells to produce terawatt levels of clean power. The development of unexplored yet promising absorbers can be hindered by complications that arise during solar cell fabrication. Here, a high-throughput, combinatorial sputtering method is applied to accelerate development of photovoltaic devices based on the novel CuSb(S, Se)$_2$ absorbers. These chalcogenide semiconductors have the appropriate band gap (1.1 -1.3 eV), absorption coefficient (10^5 cm^{-1}), and a hole concentration ($\sim 10^{17}$ cm^{-3}) for use in thin film solar cells. However, there are significant challenges to be overcome for these materials to fulfill their potential, particularly with respect controlling the properties of these ternary compounds and integrating them into solar cell architectures. Here, a high-throughput combinatorial method is applied to accelerate development of both the CuSb(S)$_2$ absorber materials as well as their integration into device structures. This approach revealed a three-stage, self-regulated growth process to control absorber purity and orientation. Device integration employed the CuIn$_x$Ga$_{(1-x)}$Se$_2$ (CIGS) device architecture, and device development is also explored in a combinatorial as a function of absorber quality and thickness using a variety of back contacts. This study yielded initial CuSb(S, Se)$_2$ device prototypes with $\sim 1\%$ conversion efficiency, which was rapidly elevated to $\sim 5\%$ using the approaches described within. Analysis of device performance provides pathways for future improvements.

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