Progress in Hybrid Perovskite Photovoltaics and Optoelectronics

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Photovoltaic devices based on hybrid organic-inorganic perovskite absorbers have reached outstanding performance over the past few years, surpassing power conversion efficiency of over 25% for single junction and present multiple paths to tandems with efficiencies beyond 30%. These efficiencies have been achieved largely via the use of solution processing of the active layer coupled to more traditional vacuum processing for contacts and interface layers. This talk will start with recent progress and challenges in hybrid perovskite solar cells (HPSCs) with an emphasis on the role of materials integration challenges needed to enable device performance, tandem processing and stability. While, this talk will highlight recent progress at NREL, the challenges of tandems based on HPSC devices, work to develop hybrid materials for other applications and to understand their basic physical properties will also be discussed. Details of material structure, synthesis, the resulting interfaces and the role of processing in creating controlling material properties will discussed. Data on the optoelectronic, spintronic and ferroelectric properties as characterized by an array of analytical tools including time resolved spectroscopy, structural studies and device level evaluation will be presented. Links from these fundamental materials properties to technologically relevant advances and suggestions for overarching research themes will be touched upon.