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Phase Transformations in Metal Halide Perovskites for Optoelectronic Applications

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Abstract:

Halide perovskite materials have attracted attention in the research community for their point defect tolerance, which give rise to state-of-the-art properties combined with solution processability. However, multidimensional defects still play an important role in their performance across length scales. Electronic defect passivation and suppression of detrimental charge-carrier recombination at the different device interfaces has been used as a strategy to achieve high performance perovskite solar cells. However, the mechanisms that allow for carriers to be transferred across these interfaces are still unknown. Albeit the rapid improvements in performance, there is still a need to understand how these defects affect long term structural stability and thus optoelectronic performance. In this presentation, I will discuss the role of crystal surface structural defects on optoelectronic properties of lead halide perovskites through synchrotron-based techniques. The importance of interfaces and their contribution to detrimental recombination will also be discussed. Finally, a discussion on the current state-of-the-art of performance and stability of perovskite solar cells will be presented.

Biographical Information

Dr. Juan-Pablo Correa-Baena is an Associate Professor and the Goizueta Junior Faculty Chair in the School of Materials Science and Engineering at Georgia Tech. He obtained his PhD degree in Environmental Engineering at the University of Connecticut in 2014 in the group of Prof. Alexander Agrios. He pursued two postdoctoral fellowships, one at EPFL in Switzerland with Profs. Anders Hagfeldt and Michael Gratzel, and another at MIT with Prof. Tonio Buonassisi. He joined the faculty at Georgia Tech in 2019 as an Assistant Professor and was promoted to Associate Professor with tenure in 2024. His group focuses on understanding the relationship between chemistry, crystallographic structures, and properties of emerging semiconducting materials for optoelectronic applications. Dr. Correa-Baena is developing deposition techniques, such as atomic layer deposition and thermal evaporation, for hybrid organic-inorganic materials with atomic and nanoscale control. His group is also developing advanced characterization methods, including synchrotron-based x-ray scattering and fluorescence, to answer fundamental questions about metastable hybrid materials. His research program has attracted funding from the Department of Energy, the Department of Defense, the National Science Foundation, industry partners, and foundations, among others. His work has been cited over 38,000 times (h-index of 68) making him a top cited researcher as recognized every year by the Web of Science Group *Highly Cited Researchers* since 2019 and Nature Index *Leading early career researcher in materials science* (2019). Dr. Correa-Baena is the recipient of numerous awards, including the Sloan Foundation Research Fellowship and the Presidential Early Career Award for Scientists and Engineers (PECASE) for his contributions to the chemistry of halide perovskites.