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Zachary Dorfman Thesis Defense
Chemical Engineering M.S. Student
Fenning Research Group

"Toward Commercial Perovskite Solar Manufacturing"

PI: Dr. David Fenning

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Abstract: Hybrid perovskite solar cells (PSCs) have received considerable attention in the hopes of a paradigm shift towards low-cost, high-efficiency light energy harvesting. In just a decade, researchers have increased the record certified power conversion efficiency (PCE) of perovskite solar cells (PSCs) from 3.8% to a record 23.3%. Much of this research has been conducted in lab-scale settings. However, to compete in the current energy sector, solutions to large-scale,cost-effective manufacturing must be engineered. Recent progress from various groups have presented viable solutions to scaled perovskite synthesis, often focusing on the absorber layer, while neglecting other necessary layers. An integral part of PSCs are electron transport layers (ETLs). ETLs serve as an electron selective barrier at the cathode and facilitate the ability to extract high currents. To date, the large-area PSC community has systematically researched scalability with insufficient reports on transport layer commercialization, specifically SnO_2 ETL industrial manufacturability. Vacuum thermal evaporation can reproducibly deposit high purity thin films, over large areas, at high volume. Combined with ease of automation, it is a highly compatible technique for assembly-line manufacturing. Herein, we report the use of vacuum thermally evaporated (vte) SnO_2 ETLs to produce stable and efficient PSCs. The fabricated vte- SnO_2 ETLs excellent coverage, confirmed through cyclic voltammetry, on substrates ranging from 5 cm^2 up to 100 cm^2. Additionally, PSC devices fabricated with VTE-SnO_2 ETLs on average display slightly higher PCE, ~16%, than our standard solution processed SnO_2 ETLs,~15.7%. These results help pave the way for commercial manufacturing of perovskite solar modules.