Doctoral Dissertation Defense

Department of Physics, University of Miami

Title

Blade Coated Perovskite Films for Efficient and Stable Solar Cells

By
Pramod Baral

Advisor: Dr. He Wang

Monday, February 20th, 2023

03:00 PM – 05:00 PM (Eastern Time)

Abstract

In the field of solar cells, perovskite materials have garnered considerable attention due to their exceptional optical and electronic properties. Despite the fact that their efficiency in converting power has reached levels comparable to traditional silicon-based solar cells, numerous obstacles still exist, such as stability, scalability, and the use of environmentally friendly solvents, along with the need for fabrication under ambient conditions. This study focuses on blade-coated methylammonium lead iodide perovskite, produced using volatile "green" solvents, such as methylamine and acetonitrile, and manufactured under normal atmospheric conditions. The film was made with a low-purity (99%) PbI_2 and was blade-coated in dry air at a relative humidity above 30%, using only a minimal amount of precursor (5µL) compared to the spin-coating method (50µL-60µL) for a 4 cm^2 substrate. The addition of a small amount of the organic halide salt phenethylammonium chloride improved the film's crystallinity and suppressed non-radiative recombination, resulting in a power conversion efficiency of over 20%. Additionally, after 500 hours of continuous illumination at 1-sun light, the device maintained more than 95% of its original efficiency at open circuit, 50°C, and 60% relative humidity. This approach represents a promising path towards the commercial production of perovskite solar cells.