Contribution ID: **256** Type: **Oral Presentation**

Ion beam modification of PANi-PMMA blends for hole transport layer applications in perovskite solar cells

Thursday, 6 July 2023 15:00 (20 minutes)

Polymer solar cells (PSCs) are a promising alternative for low-cost renewable energy due to their flexibility, simplicity in synthesis, and large-area fabrication. Methyl ammonium lead halide-based hybrid perovskite solar cells (PSCs) have been extensively studied in recent years because of their high efficiency and low processing costs. Long-term stability, however, remains a challenge as constituent layer materials are susceptible to UV radiation damage and environmental degradation. Polyaniline (PANI), a chemically and thermally stable conducting polymer, shows potential to serve both as a protective barrier and an efficient hole transport layer. Blending PANI with a structurally stable polymer like polymethyl methacrylate (PMMA) can address the issue of brittleness and cracking in pure PANI films during drying after spin coating, though at the expense of the electrical conductivity. To enhance the conductivity of the PANI-PMMA blends while maintaining their mechanical stability, doping is crucial. Metal ion implantation offers precise control over dopant dose and distribution, in contrast to conventional chemical doping methods. This paper reports on the structural, optical, and electrochemical characterization of pristine and 30 MeV Au7+ ion-irradiated PANI-PMMA blend films with varying PANI weight concentrations. The topography of the films was investigated with atomic force microscopy (AFM), ultraviolet-visible (UV-Vis) spectroscopy provides insights into the optical properties, while electrochemical measurements assess the activity and stability of the blends. The results highlight the potential of ion beam modified PANI-PMMA blends as hole transport layer materials in perovskite solar cells, contributing to their optimization for renewable energy applications.

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MSc

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Session Classification: Physics of Condensed Matter and Materials Track 1

Track Classification: Track A - Physics of Condensed Matter and Materials