Perovskite Module Scaling and Stability

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Abstract:

Perovskite solar technology is at a crossroads requiring a realistic approach to commercialization and module lifetimes. We demonstrate scalable and reproducible open-air perovskite deposition at the fastest production speeds reported, enabling large-area perovskite photovoltaic (PV) modules that can be manufactured at low cost. Perovskites have the potential to produce energy at a lower cost than silicon PV for utility-scale power generation if the modules can operate for at least 10 years. Our work demonstrates an industrially relevant attempt to address both scalable (and fast) open-air module manufacturing and studies related to the stability of the resulting perovskite modules. Our Rapid Spray Plasma Processing (RSPP) technique enabled the highest perovskite PV efficiency produced in open-air manufacturing environments. The stability of perovskite cells is addressed by considering the mechanisms related to stability of the perovskite layer itself, along with the charge transport and metal electrodes. These act often synergistically to degrade cell performance. When exposed to elevated temperatures, metal halide perovskites suffer from decomposition to PbI_2, volatilization of the organic component from the crystal structure, and even metal diffusion of the top contact through the top carrier selective contact to the perovskite. Several of these mechanisms are described together with longer term ageing and field exposures to enable a better understanding of perovskite module lifetimes and long-term stability.

Biography:

Reinhold H. Dauskardt is the Ruth G. and William K. Bowes Professor of the Department of Materials Science and Engineering, the Department of Mechanical Engineering, and the Department of Surgery in the Stanford School of Medicine. He is a Visiting Professor in the School of Materials Science at the Nanyang Technical University in Singapore.

He and his research group have worked extensively on integrating new hybrid and composite materials into emerging aerospace, device, nanoscience and energy technologies and also on the function and barrier properties of human skin and other soft tissues. He is an internationally recognized expert on open-air spray plasma processing of films and devices, and on the reliability of device technologies. He has won numerous awards including the Henry Maso Award from the

Society of Cosmetic Chemists for fundamental contributions to skin science (2011), the IBM Shared University Research Award (2011), the Semiconductor Industry Association University Researcher Award (2010), an IBM Faculty Award (2006), the ASM International Silver Medal (2003), an Alexander von Humboldt Research Award (2002), and the U.S. Department of Energy Outstanding Scientific Accomplishment Award (1989). He is a fellow of several societies including the American Ceramics Society and the ASM International.