Stabilizing Perovskites for a Brighter Future

Landmark developments in photovoltaic technologies have made it possible for the successful harnessing of energy from the sun. Monocrystalline silicon cells, as used in the Dr. Fuel Cell Professional system, and its polycrystalline silicon counterpart have long been the most popular materials used in PV applications ranging from residential to utility-scale electricity generation. To meet our energy and sustainability goals, however, further innovation of this clean energy technology is necessary. Thin film materials, such as perovskites, have immense promise in lowering costs with comparable or improved efficiency.

In discussing PV technologies, efficiency is often used as a key indicator of performance. With efficiencies between 15-18%, standard silicon solar cells set the bar for new developments in PV (Saga, 2010). Much of the buzz surrounding the much younger perovskites lies in rapid improvements in its energy efficiency, from 3.8% in 2009 to 22% in 2016 (NREL). Perovskites would be more of a rising star in the PV world if it were not for its tendency to degrade—notably upon exposure to heat and air—delaying its application in residential and industrial settings. Crystalline silicon PV on the other hand has a well-known, reliable manufacturing method and life expectancy of 25-30 years. The extreme conditions needed to form the crystalline silicon make the process both energy-intensive and costly. An added benefit of perovskites, as with other thin film materials, is low material input. This method additionally allows for thin films to be deposited on a range of surfaces, including flexible materials. PV transportation and installation derive significant benefits from these panels that can go as far as being rolled and unrolled when needed. Recent improvements to halide perovskites have made the material stable enough to permit stacking to form heterostructures and prevent rapid degradation by adding a bulky molecule, bithiophenylethylammonium, to its structure (Shi, *et al.*, 2020). This type of innovation helps to improve the viability of new materials, such as perovskites, and optimize them for commercial application.

As testing in the literature typically uses artificial light sources similar to the lamp used in the lab, supplementing methods to modify the light source can enrich one's understanding of how testing occurs in research laboratories. While the angle of incidence and distance from the light source reflect changes PV cells may experience in an outside setting, light concentrators amplify the effects of these factors. Concentration technology has the potential to improve efficiencies, as record efficiencies typically using concentrators during testing (Pérez-Higueras, 2011). Since concentrators are also increasingly being used in commercial technologies, bringing this into the lab can establish a connection between our lab and research labs at the forefront of photovoltaic technology development.

References:

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