New Polymer Nanocrystal Hybrid Architectures for High-Performance Photovoltaic Encapsulants

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Scientific Achievement:

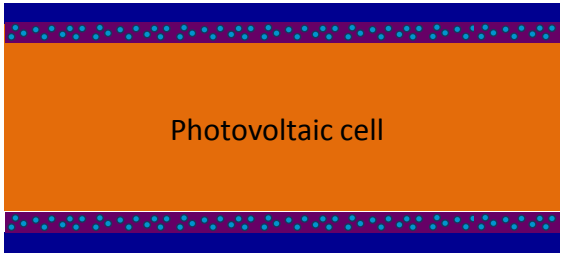
In a PV module, an encapsulating material helps cells to operate under desirable conditions and determines the lifespan of the module by protecting the cells from environmental attack. Current conventional encapsulants have several significant problems, and we are developing a new material using polymer and nanocrystals to overcome their shortcomings while also improving their properties.

Significance and Impact:

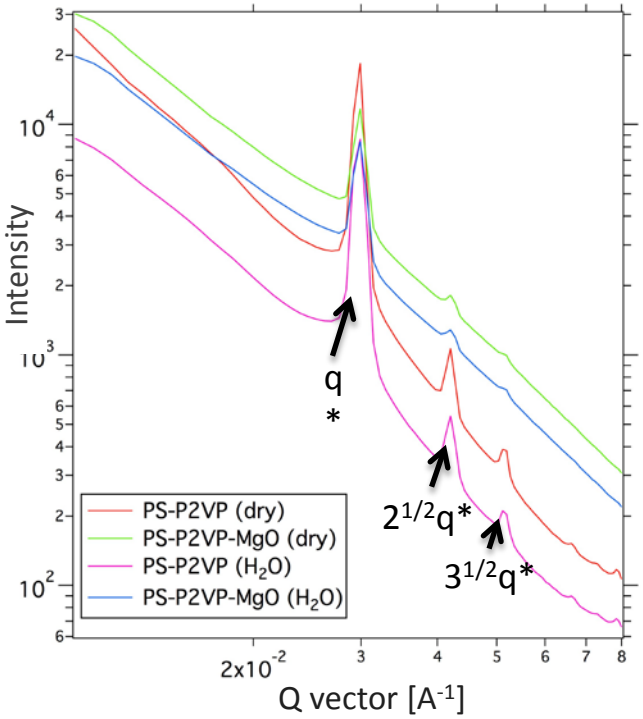
A key property for PV encapsulants is the ability to very efficiently block water vapor transmission, while also satisfying other optical and mechanical properties, especially for PV devices operating in harsh environments.

Research Details:

- PS-P2VP block copolymer is used for this application (a well-known, widely used system), and magnesium oxide nanoparticle (MgO) is incorporated into this block copolymer to enhance water vapor-blocking property due to its hygroscopic characteristic.
- Water vapor is first blocked by the hydrophobic part of polymer (i.e., PS), and permeated water vapor is absorbed by MgO, which results in preventing water vapor from penetrating the barrier.
- This was proven indirectly by SAXS measurement (shown in graph to right), where its original spherical morphology was not disturbed upon exposure to 100% humidity environment for both PS-P2VP and PS-P2VP-MgO films.



Cross-sectional representation of PV module: an encapsulating layer is indicated by purple and a backsheet by blue.



Small-Angle X-ray Spectroscopy (SAXS) characterization of various PS samples

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