NOVA SCOTIA ENERGY
R&D CONFERENCE 2014
ENERGY FOR CHANGE

Abstract:

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Category: Alternative Energy & Sustainability

Perovskite Materials as Light-absorbers in Photovoltaic Devices

The use of photovoltaic (PV) devices (i.e., solar cells) is a sustainable energy practice; it is a means to converting the Sun's energy into clean, usable electricity. However, PV devices face market barriers that include high cost and low energy density that limits their marketability and practical use. For example, first-generation PVs that use multi-crystalline silicon require energy-intensive and expensive manufacturing processes. An advantage of second-generation PV technologies is the mass-production of less-expensive thin-film devices. However, toxic heavy metals with low natural abundances (e.g., CdTe, CdSe and InAs) are often used, which hinders their viability as long-term energy solutions.

An emerging field in PV technology is perovskite-sensitized solar cells. It has been demonstrated that these inorganic crystals can function in devices with power conversion efficiencies upwards of 15%.[1] Perovskites show great promise as light-harvesters due to their stability, abundance, conductivity and desirable excitonic properties.[2] With continuing improvements, this new technology has the potential to commercially compete with existing silicon solar PV systems.

Through this research, we plan to: i) investigate new perovskite materials and ii) design simple PV device architectures that both increase device efficiency and longevity. The structural features of the perovskites are characterized by techniques such as X-ray diffraction (XRD), scanning electron microscopy (SEM) and atomic force microscopy (AFM). Understanding the morphology of the photo-active materials is critical to building better-performing devices.

By synthesizing and characterizing these cheap and abundant materials, we aim to demonstrate the feasibility of commercializing robust and efficient perovskite solar cells as sustainable energy harvesters.