Abstract

Third generation photovoltaics: organic, hybrid, perovskite and all inorganic-nanoparticle, have developed significantly over the last four decades due to the promise of cheap, flexible power sources. Though they have impacted the consumer electronics landscape, such devices have not dominated the market as has been long predicted, as they still suffer from stability and performance issues. In our work at McMaster, we focus on easy, versatile, and inexpensive methods of exploring and tuning interfaces in such devices to tackle these critical problems, using nanoparticles. Incorporation of nanoparticle interlayers at the electrode surface is a key design strategy for improving device efficiency, light management, and operational stability.

Self-assembly of amphiphilic block copolymers is a model example of "bottom-up" approach to the construction of nano-objects on large areas. Di-block copolymers, due to their amphiphilic nature, spontaneously form core-corona micelles in selective solvents. Using the micelles as “nanoreactors” allows the formation of highly controllable nanoparticles. The advantage of the reverse micelle approach is the control over the 2D dispersion: highly ordered periodic arrays to complete spatial randomness are achieved with simple tuning of deposition parameters. In this contribution, I will outline our recent work on producing various nanoparticles using reverse micelles, from an understanding of the basic loading behaviour, the stability and the organizational structure of the micelles, to the properties of the nanoparticles and their impact in devices to outline how we utilize these powerful nanoreactors systems for various PV applications.