Abstract

Integrating solar-harvesting systems into the built environment is a transformative route to capturing large areas of solar energy, lowering effective solar cell installation costs, and improving building efficiency. Indeed, the idea of luminescent solar concentrators (LSC), which were first introduced in the 1970s to reduce solar cell costs, are now regaining attention as low-cost solar harvesting systems to deploy around the building envelope. However, the visible absorption and emission of these LSCs result in highly colored systems that hamper their widespread adoptability in many applications, including windows. Here, we introduce the concept of transparent luminescent solar concentrators (TLSC) that can selectively harvest ultraviolet (UV) and near-infrared (NIR) without impacting visible light, and which create an entirely new paradigm for power-producing transparent surfaces that can be deployed in windows, displays, and beyond. In the first configuration, we have designed systems composed of novel metal halide phosphorescent luminophore blends; these nanoclusters enable selective harvesting of UV photons with absorption cutoff positioned at the edge of visible spectrum (430nm) and massive-downconverted emission in the near-infrared (800nm) with very high quantum yields for luminescence. In the second configuration, we have developed transparent luminescent solar concentrators employing fluorescent organic salts with both efficient NIR absorption and emission. We describe the photophysical properties and electronic performance of both classes of devices, the impact of ligand-host control, and architecture optimization. These TLSCs present new opportunities for clear solar-
harvesting surfaces and windows that can translate into improved building energy efficiency, autonomous mobile electronics, and lower cost solar harvesting systems.