Functional Materials and Enabling Fabrication Methods for High Performance, Low-Cost Energy Systems: Photovoltaic Energy Conversion, Electrochemical Energy Storage, and White Light

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The fabrication of high performance integrated circuits provides examples of the most sophisticated manufacturing methods, as well as the most high performance materials, used in an area of modern technology. The advanced functional systems they provide are ones that are generally characterized by a massive integration of circuit elements within compact, rigid and essentially planar form factor devices. New means of fabrication and enabling materials are beginning to provide a set of means through which it is possible to lift some of these latter constraints—doing so in ways that both retain capacities for high performance while enabling new, low cost opportunities for use in technology. Our collaborative research here at the University of Illinois is providing form factors for devices with interesting but what had been to date difficult to realize features. Examples include: light weight, large area, high performance electronics, optics, and photonics; electro optical systems with curvilinear shapes and capacities for accommodating demanding forms of mechanical flexure; and hybrid systems for lighting, energy storage, and photovoltaic energy conversion that might provide potentially transformational approaches to supplant current technologies with high performance, low cost alternatives. In this lecture I will explore examples of energy technologies enabled by new form factors for devices, highlighting three exemplary cases where opportunities for progress have benefitted from a reexamination of the modes for incorporating highly functional electronic materials into advanced, fully integrated modules.