NANOSTRUCTURED OXIDE PHOTOELECTRODES FOR SOLAR ENERGY CONVERSION

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Abstract

The efficient capture, conversion, and storage of solar irradiation is the most promising route for sustainably producing carbon-neutral energy at a scale commensurate with global energy use. Abundant solar energy can be directly converted to chemical energy stored in hydrogen through water splitting using a photoelectrochemical device. However, traditional approaches to accomplish this “solar fuel” production with high efficiency are limited by the high cost and poor stability of the employed semiconductor devices, which require the use of rare, high purity, and highly crystalline materials. A new paradigm in solar energy conversion is needed to enable the use of low to medium purity materials while still obtaining high solar-to-fuel conversion efficiencies. In this talk I will detail our progress using abundant, inexpensive, and environmentally benign oxides such as alpha-Fe2O3 and Cu2O as semiconductors to efficiently store solar energy. I will show specifically how the limitations brought by these materials can be overcome with inexpensive “bottom-up” nanostructuring techniques, and by taking inspiration from natural photosynthesis to afford high performance water-splitting photoelectrochemical cells.

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