NANOCRYSTALLINE JUNCTIONS, FROM TRANSISTORS TO HIGH POWER LITHIUM BATTERIES, FAST DISPLAYS AND EFFICIENT SOLAR CELLS

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Nanocrystalline films are made up of a network of mesoscopic oxide particles such as zinc oxide, tungsten trioxide niobium oxide and titanium dioxide, which are interconnected to allow for electronic conduction to take place. The pores between the particles are filled with a semiconducting or a conducting medium, such as a p-type semiconductor, a polymer, a hole transmitter or an electrolyte, constituting a junction of extremely large contact area. In this way interpenetrating bicontinuous network composites are formed which are phase-separated by a heterojunction. Electrons can percolate rapidly across the network of nanoparticles allowing the huge surface area to be addressed electronically. At present these mesoscopic oxide films have already found a number of important applications, including as gate materials for transistors, high power lithium ion intercalation batteries, dye sensitized photovoltaic cells, electrochromic displays and biosensors. Examples of these devices will be presented and their mode of operation discussed.

Professor Michael Graetzel is one of the world’s renowned scientists in the fields of photo and electrochemistry. A decade ago, he made a breakthrough discovery in the field of solar energy, that allowed the construction of a new, inexpensive solar cell that mimics photosynthesis. This cell and a number of other ‘next generation solar cell’ models that it has inspired, show great promise in making inexpensive solar energy a large-scale, viable option for the future.