Learning from the concepts used by green plants in solar energy harvesting and conversion, we have developed a molecular photovoltaic device that is based on the sensitization of nanostructured oxide films by a molecular chromophore or a semiconductor quantum dot. Reported in 1991 [1], the dye sensitized mesoscopic solar cell was the first device to use a three-dimensional junction for solar light energy harvesting and conversion [2-4]. It is also the only photovoltaic device that achieves the separation of the functions light absorption from charge carrier transport. As in natural photosynthesis, the role of the sensitizer is to absorb light and generate electric charges. The latest progress in the molecular design of sensitizer and charge transport materials has enabled unprecedented photovoltaic performance to be attained. The solar to electric power conversion efficiency has reached 12.3% on the laboratory cell scale [5] and 10% on the PV module level, fostering first industrial applications. Mass production of flexible lightweight cells and glass modules on the megawatt scale has been launched. The low cost and ease of production of the new cell will benefit large-scale applications. Our recent research progress on efficient solar water splitting using mesoscopic n-type Fe₂O₃ [6] and p-type Cu₂O photo-electrodes will also be presented [7]. These systems will promote the acceptance of renewable energy technologies, not least by setting new standards of convenience and economy.

**Figure 1.** Left: Schematic presentation of a solar cell based on the sensitization of nanocrystalline TiO₂ particles (grey colour) by dye molecules (red color). Right: photograph of a glass module presenting a dye sensitized solar cell using a green porphyrin sensitizer achieving 12 percent efficiency in converting sunlight to electric power [5].
**Figure 2.** Left: scanning electron microscopy picture of a silicon doped hematite film supported on fluorine doped tin dioxide (FTO) conducting glass. Note the cauliflower-type nanostructure obtained by APCVD. The feature size is about 14 nm. Right: Oxygen bubble formation from water oxidation by visible light by a nanostructured Fe$_2$O$_3$ film.

References: