Research project

Luminescent nanocrystals for solar energy conversion

The research project will be aimed at the design and realization of a photoelectrochemical cell for the conversion of solar energy into chemical energy (molecular hydrogen production). Within this project, the research activity of the candidate will be related to the design and synthesis of photoactive nanocrystals for the solar energy conversion. This research is funded by the research project entitled: “Solar hydrogen via integration of energy conversion technologies” (SHINE).

The design and synthesis of the photoactive systems will take into account the following requisites: (i) absorption in the required spectral range (blue portion of the visible spectrum) with large molar absorption coefficient; (ii) photostability under the investigated reaction conditions; (iii) proper redox properties for efficient photoinduced electron transfer processes occurring within the photocatalytic system. The first requirement related to the absorption of UV and blue light of the solar spectrum is dictated by the SHINE concept: a dichroic device will be used to concentrate the blue-UV portion of the solar spectrum on a photoelectrochemical cell for the production of solar fuels, while the green-red-IR portion of the solar spectrum will be transmitted to a silicon photovoltaic module, capable of producing electricity with high efficiency.

The selected luminescent nanocrystals (e.g., Si nanocrystals and $CuInS_2$ nanocrystals) will be synthesised and characterised from the structural, photophysical and electrochemical point of view. The synthetic procedure will be optimised in terms of photochemical properties and sustainability. The photophysical properties and the photocatalytic mechanism will be studied by steady-state and time-resolved techniques in the ultraviolet, visible and near infrared spectral region; the electrochemical characterisation will be mainly based on cyclic voltammetry with conventional and ultramicroelectrodes and it will be accompanied by spectroelectrochemical investigations.

The candidate will design the synthetic strategy, the photochemical experiments and will carry out a bibliographic search to keep updated with the recent developments in the field.