LIGHT-TRIGGERED ION TRANSFER IN SEMICONDUCTING MATERIALS: TiO$_2$ NANOCRYSTALS CASE

Iryna Sagaidak$^{1,2}$, Gaspard Bouteau$^{1,2}$, Christian Andriamiadamanana$^{1,2}$, Albert Nguyen Van Nhien$^3$, Frédéric Sauvage*$_{1,2}$

$^1$Laboratoire de Réactivité et Chimie des Solides, Université de Picardie Jules Verne, CNRS UMR7314, 33 rue Saint Leu, 80039 Amiens Cedex
$^2$Réseau sur le Stockage Electrochimique de l’Energie (RS2E), FR CNRS 3459, France
$^3$Laboratoire de Glycochimie, des Antimicrobiens et des Agroressources, Université de Picardie Jules Verne, CNRS UMR 7378, 33 rue Saint Leu, 80039 Amiens Cedex

E-mail: iryna.sagaidak@u-picardie.fr

An increase of the worldwide population, energy consumption per capita together with depletion of fossil fuels prompt the development of alternative sustainable energy sources. The use of solar energy by means of photovoltaic systems in the day-to-day life is hindered by the intermittent nature of the sun power. Nowadays, hybridization between photovoltaic modules and a storage feedstock is required to ensure the grid stabilization in the delocalized future grid deployment. One innovative approach would be to develop a new technological paradigm with a device able to combine energy conversion and energy storage functions. Interestingly, Tributsch was the first to demonstrate that interfacial ion transfer can be onset in semiconducting materials [1]. In our group, we pursued this approach on bifunctional materials combining conversion and storage capabilities. This work led to the demonstration of a first photo-rechargeable half-cell lithium battery which can be recharged by light in less than 1-hour exposure and to a concept of non-intermittent PV device, thus closing the gap between electrochemical energy storage batteries and photovoltaics [2]. In the current oral communication, we will be presenting this interesting concept based on anatase TiO$_2$ nanocrystals electrode together with insights into photoelectrochemical mechanisms involved during the electrode photorecharge and their limitations [3].

Figure 1. Schematic representation of the charge separation and Li$^+$ de-insertion processes in Li$_x$TiO$_2$ / TiO$_2$ nanocrystals under incident sunlight