PHOTORECHARGEABLE BATTERY ELECTRODE BASED ON NANOCRYSTALLINE ANATASE TiO_2

Gaspard Bouteau[1,2], Iryna Sagaidak[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 UMR7378, 33 rue Saint Leu, 80039 Amiens Cedex*

E-mail :gaspard.bouteau@u-picardie.fr

Renewable energy technologies, such as photovoltaics, are characterized by their intermittency which penalizes large scale implementation without its hybridization with an energy feedstock. Electrochemical batteries offer an elegant solution to stabilize the grid and to balance energy production and end-user demand. Even though, photovoltaics and batteries are two mature technologies, their hybridization requires accurate dimensioning of both parts: a battery sustaining high current peaks and management electronics enabling the battery protection in case of high energy production or alternatively at low light power.

At a long term view, the approach of combining the two functions: solar conversion and its storage at the molecular level is worth at developing for both scientific and technological point of view. This will pave the way towards photo-rechargeable ion batteries which can be also considered as a non-intermittent photovoltaic displays.

Towards such ground-braking materials, Tributsch first demonstrated in the early 80's the possibility to trigger light-induced interfacial ion transfer in mixed electronic/ionic p-type semi-conductors. This phenomenon stems from the effective charge separation process taking place within the depletion region [1]. This light activated reaction is only confined to the extreme surface of the particles. This leads to a strong limitation in terms of storage capability of less than 1Wh/kg at the material level [2]. In order to overcome this key limitation, our approach consisted in the synthesis of down-sized anatase TiO_2 electrode composed of 4 nm size nanocrystals [3][4]. Promoting the surface to the volume offers a new paradigm in the field as it affords to quantitatively de-insert lithium under illumination as a consequence of the hole transfer towards the Ti^{3+} state in Li_xTiO_2. Consequently, thanks to this approach led to nanocrystals, this type of electrode material shows the possibility to be integrally photorecharged (ca. 700 $\mu Ah/cm^2$ capacity) in about one-hour light exposure [5] (Fig. 1). In this poster communication, we will discuss on both aspects: synthesis and characterization of these 4 nm size nanocrystals and on their photoelectrochemical properties when integrated into a half cell photonic lithium battery.

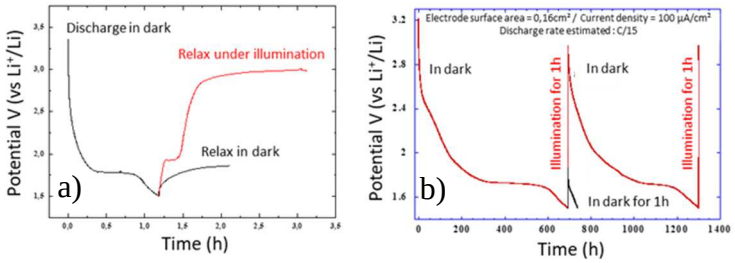

Figure 1. *(Photo)electrochemical properties of anatase TiO_2 nanocrystals in carbon-free mesoporous electrode: a) evolution of open circuit voltage in dark versus illumination, b) subsequent galvanostatic discharge after photo-recharge*

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