Study of Plasmon-enhanced water splitting in a hematite photoanode

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Photoelectrochemical water splitting can use sunlight energy to produce hydrogen gas from water through the electron transfer between an aqueous electrolyte and a semiconductor electrode [1]. Metal oxides are very abundant and stable in aqueous conditions, however their use as semiconductor electrode has been subject to some limitations so far, either because they absorb only short wavelength light (TiO_2, WO_3) or because their charge transport properties are poor ($\alpha - Fe_2O_3$, $BiVO_4$). A suitable hematite ($\alpha - Fe_2O_3$) photoanode needs to be designed with very small features such that light is absorbed close to the semiconductor/electrolyte interface [2]. Addition of plasmonic nanoparticles as the potential of increasing the quantity of light absorbed in such thin films, through the high near field intensity produced at resonance [3]. Electromagnetic simulations with a surface integral equation method are performed to compare different designs and different possible plasmonic material in combination with hematite. A fabrication technique for making a porous hematite film with electrospinning is presented and the effect of adding plasmonic nanoparticles is studied.

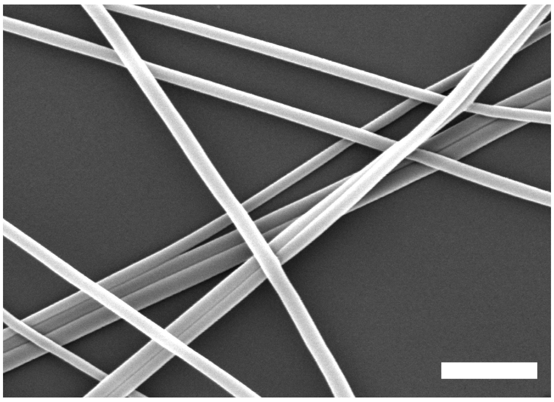

Fig 1: SEM image of composite PVA/$Fe(NO_3)_3.9H_2O$ fibers deposited with electrospinning (scale bar : 2μm)

[1] M. Gratzel, *Nature*, **2001**, *414*, 338–344
[2] A. G. Tamirat et al., *Nanoscale Horiz.*, **2016**, *1*, 243-267
[3] X.-C. Ma et al., *Light Sci. Appl.*, **2016**, *5*, e16017