**The Ink-Jet Printed Nanostructured TiO2 Film Electrode**

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2011

# The ink-jet printed nanostructured $TiO_2$ film electrode

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The high potential of the nanostructured semiconductor oxides in the thin layers form for the utilization as a part of sensors, optical electrodes or solar cells has recently evoked a great interest in the manipulation and optimization of their photoelectrochemical properties. As generally known, these photo-induced properties arise from the semiconductor nature, especially from the ability of the light quantum absorption followed by the charge carrier generation. Titanium dioxide in crystallographic form of anatase is a promising semiconductor widely used in the field of the advanced oxidation processes and the photoelectrochemical sensing due to its excellent efficiency to generate the electron-hole pairs. Nowadays, a variety of deposition techniques and preparation methods of the thin $TiO_2$ layers created from the liquid precursors exist. This study reports the electrochemical properties of the $TiO_2$ layers prepared by means of the templated sol-gel method and deposited by the inkjet printing.

Inkjet printing proved to be very elegant and clean technique for the sol deposition. The sol-gel method is based on hydrolysis followed by polycondensation of titanium alkoxide (TIOP) in the core of reverse micelles, where a small amount of water is involved. The micelles are formed by surfactant Triton X 102 in the nonpolar environment of cyclohexane. Prepared sol is loaded into a modified office inkjet printer equipped with the piezoelectric print head. Then small droplets are ejected from the print head and fall onto the conducting ITO glass. The glass plates with printed layers were dried in an oven at 110° C for 30 min and then the samples were thermally treated by calcination at 450° C for 4 hours. The sol deposition and patterning was performed by an adapted experimental inkjet printer Fujifilm Dimatix 2830.

The structure properties of the prepared layers were studied by series of characterization methods involving AFM, SEM, XRD, Raman and UV-Vis. Photo-induced electrochemical behaviour of $TiO_2$ electrode was investigated by potentiodynamic methods in a three-electrode electrochemical cell containing 0.1 M solution of sodium sulphate which was used as an electrolyte. A saturated Ag/AgCl electrode and a platinum plate were used as the reference and the auxiliary electrodes, respectively. The exposed area of the working $TiO_2$/ITO electrode was irradiated by monochromatic light and the photoelectrochemical reaction was monitored.

*This work was supported by the Grant Agency of the Czech Republic, projects No. 203/08/H032 and of the Czech Academy of Sciences, Program Nanotechnology for Society (KAN400720701) is gratefully acknowledged.*

*Keywords: Ing-jet printing, Photoelectrochemical, thin $TiO_2$ layers, sol-gel*