Thin Photoresponding Elements with Frequency and Amplitude Modulations

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Nanoscale templated metal oxide thin films undoubtedly appertain to the most extensively studied materials due to their optical and electrochemical properties. Their photo-induced properties arise from the semiconductor nature, especially from the ability of the light quantum absorption followed by the charge carrier generation. In order to produce metal oxide thin layer layers, the liquid sol containing also the templating bodies, and confining nanoparticles, must be coated onto a substrate. Various coating techniques have been used for this purpose, such as dip-, spin- or spray-coating. Recently a new promising deposition technique has appeared. The novel approach is usually termed piezoelectric jet material deposition or shortly material printing. In this case the ink is the specially formulated liquid purposed for transporting functional components onto the substrate surface. This technique brings the possibility of direct patterning, i.e. the fabrication of 2D patterns on the substrate without the need of any mechanical or optical masking. Material printing has been already employed for the deposition of variety functional materials.

Many metal semiconducting oxides materials reveal photoelectrocatalytic activity toward oxidation of various organic compounds. This process might be in principle used also for detecting organic substances in aqueous solutions based on monitoring steady-state photocurrents. It is known that, e.g., at the anatase TiO_2 nanoporous electrode the potential bias changes the rate-determining step from electron migration in the film at low potentials to photohole capture at relatively high potentials. When the applied potential bias is sufficient, the steady-state photocurrent obtained reflects exclusively the rate of the photohole capture (scavenging) at the metal oxide surface. A typical model compound for such experiments is oxalic acid, but in principle it might be any organic matter dissolved in water, even at very low concentrations. Photocurrents collected from the interface between the polycrystalline anatase and the aqueous solution of oxalic acid are measured as a function of oxalic acid concentration.