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Electrochemical surface modification of metal oxides for security applications and healthcare

Vardan Galstyan[1], **Andrea Ponzoni**[1], **Nicola Poli**[1], **Elisabetta Comini**[1], **Giorgio Sberveglieri**[1], **Iskandar Kholmanov**[2] and **Veronica Sberveglieri**[3]
[1]University of Brescia, Italy
[2]The University of Texas, USA
[3]Institute of Biosciences and Bioresources, Italy

Statement of the Problem: Chemical sensors have received great attention for the fabrication of small-size and mobile gas sensing devices for the environmental monitoring and clinical diagnostic. One-dimensional metal oxide nanomaterials are very promising structures for the application in chemical gas sensing. However, the sensing performance of these materials needs to be improved for the manufacturing of sensing systems with the high sensitivity, selectivity and stability. Herein, we report the synthesis of highly ordered titania nanotubes and the modification of their structure and surface for the chemical sensing applications.

Methodology & Theoretical Orientation: Well-ordered titania nanotube arrays were prepared by electrochemical anodization. The anodization process was performed in the electrochemical cell with the two-electrode system. Preparation of titania nanotubes by means of electrochemical anodization is anodic formation of nanotubes by oxidation and etching of metallic titanium films. Pt foil was used as a counter electrode. The anodization was carried out by potentiostatic mode at room temperature. This method allows direct growth of the titania nanotubes on different type of substrates and the modification of their surface structure at room temperature. The morphological, structural and elemental analyses of the obtained samples were performed. The sensing properties of the materials were tested towards different, explosive and toxic gases.

Findings: Pure and doped nanotubes have been obtained by the modification of anodization parameters. Our studies have shown that the engineering of the band gap and the functionalization of the surface structure of titania enhanced its gas sensing performance.

Conclusion & Significance: Investigations have shown that the response and the selectivity of titania nanotubes are improving depending on the modification of their composition and their functionalization. Meanwhile, the developed method is promising for the fabrication of high performance and small size chemical gas sensors.

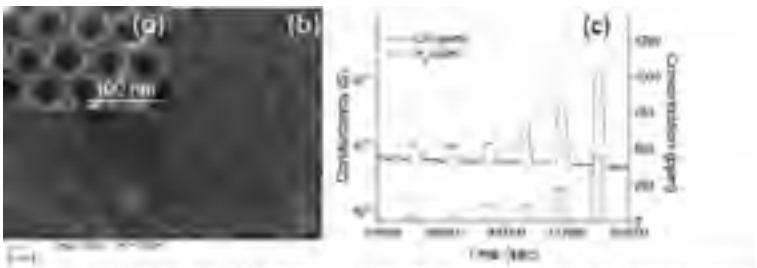

Figure 1: (a) and (b) SEM micrographs of the prepared nanotube arrays with the different magnifications. (c) Variation of the sample conductance as a function of the introduction of different concentrations of CO (30, 60 and 120 ppm) and H_2 (120, 240 and 480 ppm) at 300 °C.

Biography

Vardan Galstyan is now a Researcher at the Sensor Lab, Department of Information Engineering, University of Brescia (Italy). His activity is dedicated to the developments of the synthesis methods using electrochemical approaches for the preparation of nanomaterials and nanocomposites (mainly metal oxides and graphene based materials). He has worked on characterization of the obtained structures for the applications in biosensors, energy storages, photocatalysis and biomedicine. He is serving as a peer reviewer for the different international journals including *Journal of Materials Chemistry A, Journal of Materials Chemistry C, ChemComm, ACS Applied Materials & Interfaces, Nanoscale, Physical Chemistry Chemical Physics, Sensors & Actuators: B. Chemical, CrystEngComm,* etc.

vardan.galstyan@unibs.it