

# Proceedings of the BaltSilica 2014

---

*Adam Mickiewicz University in Poznan  
Faculty of Chemistry*

**Poznan, Poland**

**1-3 June 2014**



## The Development of Nanostructured TiO<sub>2</sub> Sol-Gel Derived Coatings – the Influence of Substrate Preparation Method and Post Treatment of Coatings

G.Mezinskis

Institute of Silicate Materials, Riga Technical University, Paula Valdena Str. 3, Riga,  
LV – 1048, Latvia, [gundarsm@kif.rtu.lv](mailto:gundarsm@kif.rtu.lv)

Sol-gel derived TiO<sub>2</sub> photocatalysts are of strong interest and intensive experimental and theoretical studies due to increasing applications in hydrogen generation, solar energy utilization, environmental remediation and biomedicine. The growth of 3D nanostructures of oxides was successfully achieved in the form of nanowire, rod, tube, flower-like clusters via well-established chemical syntheses methods. Design rules are urgently needed for the synthesis of hierarchical micro/nanostructured thin films by exploiting the analogy of nanoparticles, and robust, highly reproducible synthesis is vital for such studies [1]. The objectives of this research is to review the literature regarding less studied surface preparation methods and sol-gel thin film surface nanostructure modification methods to secure the development of designed nanostructures.

Chemical deposition techniques of thin TiO<sub>2</sub> films such as dip- and spin-coating, spray pyrolysis, capillary coating, electrophoretic and liquid phase, SILAR method deposition, and their characteristic features are briefly reviewed.

Nanostructured TiO<sub>2</sub> films were prepared on a variety of substrates including silica, borosilicate, soda-lime silicate glasses, polymer, textile, metal, and ceramic surfaces. Surface preparation methods are divided in physical methods which may change surface roughness, grain sizes, grain boundaries, and chemical ones which change chemical functionality, chemical composition at the surface of a material, surface charge, porosity, roughness, specific surface, chemical durability, and uniformity. A review of the surface preparation methods used prior the deposition of sol-gel coatings depending on the substrate material is presented.

Glass substrates are widely used to test new sol-gel compositions, to evaluate the impact of doping elements, thermal and chemical treatment procedure variations onto structural, physical and chemical properties of resultant TiO<sub>2</sub> films. However published research results regarding the impact of glass substrate preparation method onto the development of titania nanostructures in most of cases are quite limited in terms of usability. The description of surface preparation for coating deposition has to be considered as incomplete due to the lack of data characterizing substrate micro- and nano structure.

The methods of deposited TiO<sub>2</sub> film modification by the use of UV treatment, laser radiation, and incorporation of graphenes in TiO<sub>2</sub> films have been discussed briefly.

Most studies devoted to the development of nanostructured TiO<sub>2</sub> coatings focus mainly on the nanostructures obtained and bulk properties of the catalyst. The analysis of literature data and experimental results obtained by the Author of the report clearly showed that further researches shall be devoted to the surface preparation method and characterization of the substrate obtained to check the dependency of morphological features whether they are characteristics of sol or substrates.

### References

- [1] Yun-Pei Zhu, Tie-Zhen Ren, Tian-Yi Ma, Zhong-Yong Yuan. *Int. J. Photoenergy*, 2014, No.498540.