Self-organizing anodization: Formation of properties of highly ordered TiO_2 nanotube layers

Patrik Schmuki
Department of Materials Science WW-4, LKO, University of Erlangen-Nuremberg,
Martensstrasse 7, 91058 Erlangen, Germany
*schmuki@ww.uni-erlangen.de

Self-organizing anodization has in the last 30 years been successfully employed to fabricate not only ordered porous alumina layers, but in addition other aligned nanoporous and nanotubular materials including semiconductors and functional oxides such as titania.
TiO_2 nanomaterials have attracted tremendous scientific and technological interest. Main research directions using TiO_2 in functional applications is the use in Grätzel type solar cells, biomedical applications or the use in photocatalysis, e.g. for the direct splitting of water into H_2 and O_2 to generate the potential fuel of the future, hydrogen.
Over the past decades, various 1D and highly defined TiO_2 morphologies were explored for the replacement of nanoparticle networks and were found in many cases far superior to nanoparticles or their assemblies. Nanotubes grown by self-organizing anodic oxidation are aligned perpendicular and directly back-contacted to the conductive substrates and therefore can be directly used as functional electrodes (e.g. photo-anodes).
Self-ordered nanotube formation is not limited to pure titanium substrates but can also be formed on a wide range of alloys. This allows the fabrication of advanced advanced and doped morphologies. The presentation will focus on these highly ordered nanotube arrays of TiO_2 and discuss most recent progress in synthesis, modification and applications.

Literature (reviews):

P. Roy, S. Berger, P. Schmuki, Angew. Chem. Int. Ed. 50 (2011) 2904
K. Lee, A. Mazare, P. Schmuki, Chemical Reviews 114 (2014) 9385
X. Zhou, N. Liu, P. Schmuki, ACS Catalysis (in press, 2017) DOI:10.1021/acscatal.6b03709