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Nanostructured TiO_2 growths by MOCVD. Openings for energy and environmental applications

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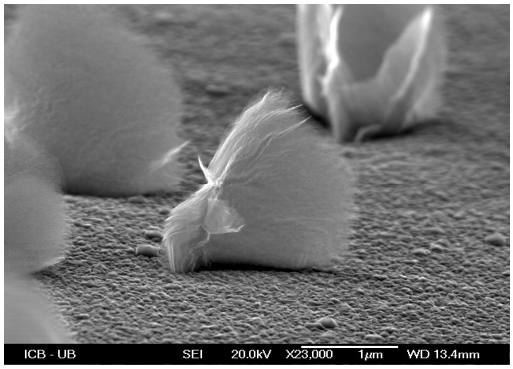
Nanostructured materials have been the subject of intense scientific and technological interest because of their stable, controlled, nanoscale morphologies that promise enormous benefits in applications such as catalysis, electronic, optoelectronic and photovoltaic devices, chemical and biological sensors, and functional materials. Fabrication of 2D and 3D assemblies with ordered nanostructures are nowadays the trend in nanosciences and nanotechnology due to their dimensions and very high surface areas.

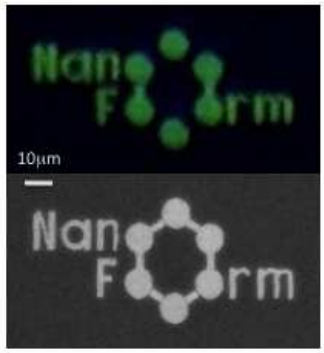
Titanium oxide is an interesting material because it is chemically and thermally stable and can be used in various applications: solar cells, photocatalysis, air purification and visible light emission devices. It is a wide-band-gap semiconductor (3.2 eV), which can be chemically activated by light and the material tends to decompose organic materials as a result of photo-catalytic processes. Titanium dioxide films have great potential, since they have high surface areas and controlled nanoscale morphologies coupled with relatively high refractive indices (1.5 to 1.6). The properties and the activity of TiO_2 are influenced by the crystal structure (anatase and/or rutile), surface area, porosity etc…

Recently, there have been reports on the preparation of nanoscaled titania in various morphologies such as nanoparticles, nanorods, nanowires, and nanotubes with the aim of significantly increasing its specific surface area and delocalization of carriers, which may improve the performance of this material in highly efficient sensors, photocatalysis, and photovoltaic cells.

In this work, we present some unusual nanostrcutured TiO_2 growths (nanometric thickness leaves like leaves of palm trees, trees, nanorods, TiO_2 Nanoparticles on CNT, nanocrucibles, nanodots, lines, scattering networks, layers with porosity controlled, amorphous and semi-crystalline layers, etc…) obtained by Metal-Organic Chemical Vapor Deposition (MOCVD) coupled with various techniques (Colloïdal metallic nanoparticles, Electron Beam Physical Vapor Deposition (EBPVD), Thermal Physical Vapor deposition, electronic lithography, etc…) and using various catalytic agents (gas, metallic, Co…). The proposal of using other catalysts for nanostructured materials growths can be advantageous in improving the next technological steps.

We present also some applications we developed and the benefit that we get using theses new TiO_2 nanostructures : Li-ion batteries, photocatalysis, organic solar cells, in laser application, in biology applications and semiconductor.





Figures : A) NanoLeaves (10 nm x2 μm x2 μm) C) Scattering networks