New Generation of Low-Cost/High-Efficiency Solar Photocatalysts for Solar-Driven Energy and Environmental Applications

Beatriz Gallego-Gómez, Daniel Fernández-Hevia

INAEL Electrical Systems
C/ Jarama, 5 – Polígono Industrial
Toledo (Toledo), Spain
bgallego@inael.com

Nowadays, the global interest on energy production from renewable resources is increased. There is a pressing need to accelerate the development of new technologies in order to address the global challenges of energy security, climate change and economic growth. Solar photocatalysis has demonstrated enormous potential for solar-driven energy and environmental applications: It is a safe and sustainable process that consumes minimum resources.

Nanotechnology and nanostructured materials have the potential to significantly impact efficiency, storage, and production of energy. Such applications can be used to monitor and remediate environmental problems, and develop new, green processing technologies that minimize the generation of undesirable by-product effluents.

INAEL has created a division of advanced materials, stemming from the ceramic semiconductor manufacturing plant that has been producing ZnO-based and TiO_2-based polycrystalline semiconductors for the last 12 years. We have focused on the development of a new generation of durable, low-cost/high-efficiency/solar-active photocatalyst materials, based on new forms of TiO_2, either as hierarchical microspheres, self-assembled from nano-building blocks, or as morphology controlled anatase nanoparticles exposing high percentages of reactive facets. In all cases production routes are mild, environmentally friendly, easily scalable, and do not make use of aggressive or harmful surfactants. Doping and extension of optical absorption towards the visible range is also achieved through low-cost/high-yield processes such as mechanochemical alloying.

A new generation of solar-driven photocatalysts of cost-efficient photocatalysts of high durability, based on new forms of doped titanium dioxide, and new production routes strongly related with the concepts of green chemistry have been developed in INAEL with the strong collaboration of research organizations (ICV-CSIC and ULPGC). Synthesis proceeds in reaction vessels at room temperature and atmospheric pressure, and without the use of harmful and industrially unsuitable surfactants such as hydrofluoric acid. Alternatively, other synthesis routes proceed through surfactant-assisted sol-gel techniques of high industrial yield.

Figures

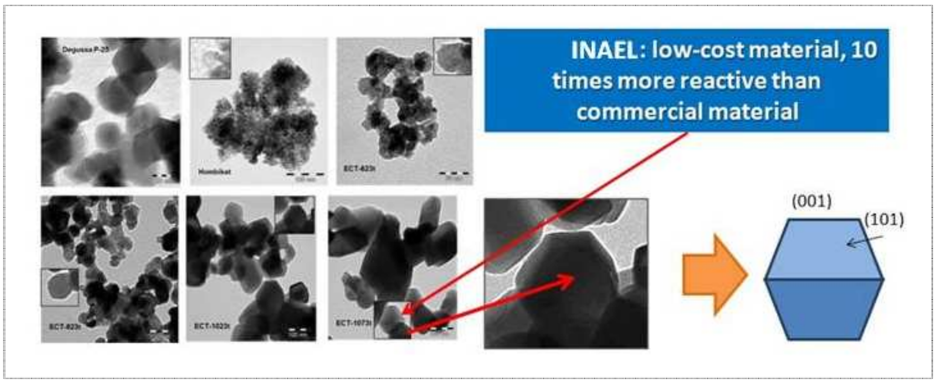

Figure 1.TEM micrographs of commercial and new TiO_2 catalysts. ECT-1023tTEM micrograph detail and scheme indicating the crystallographic planes identification in the particles of (001)-faceted anatase material

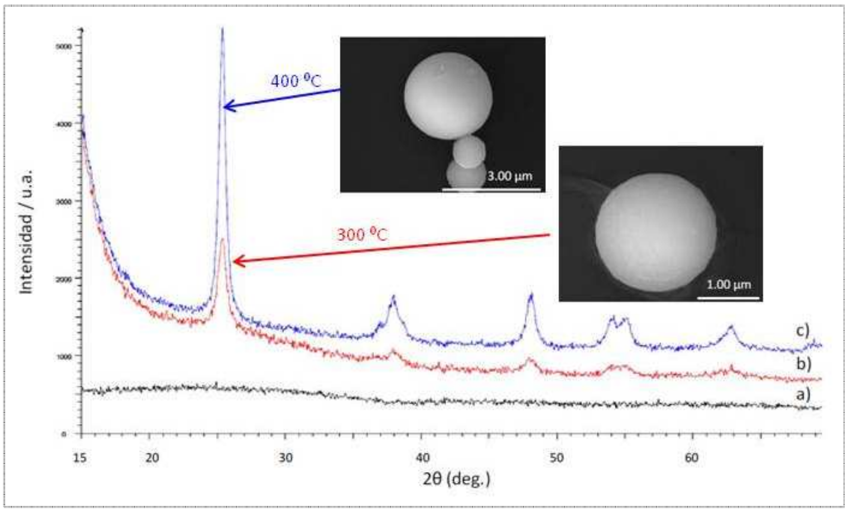

Figure 2. XRD of TiO_2 low-temperature synthesized microspheres.