Photocatalytic activity of ZnO nanostructures grown by vapour and solution

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Zinc oxide (ZnO) is one of the most studied functional materials in the last years because it matches the opportunity to be easily synthesized in nanocrystalline form (with different morphologies and by different growth techniques) with a very large number of possible applications in different fields (optoelectronics, photovoltaics, piezoelectric devices, gas-sensing and bio-sensing, photocatalysis, spintronics, nano power generators, cantilever production, etc.).
In the present contribution we report on ZnO nanocrystalline structures, with the same wurtzite structure but different morphologies, synthesized by vapour-phase and by solution growth techniques.
More in detail, ZnO nanotetrapods and nanopowders with different size have been obtained by a combination of metallic Zn thermal evaporation and controlled oxidation in a non-standard CVD (chemical vapour deposition) reactor where temperature have been set in the 450°C-650°C range. Other ZnO multi-branched nanostructures, resulting from aggregation or twinning of nanosized crystals, have been grown in aqueous solution of zinc salts and hexamine, in slightly alkaline medium below 100°C. Moreover, ZnO nanopowders have been obtained by thermal decomposition of a metallorganic gel precursor, resulting from dehydration of a zinc citrate solution. Different nanopowders samples have been prepared with different decomposition processes (time, temperature).
ZnO nanostructures have been later on deposited on a photocatalysis-inert substrate (glass) from an alcoholic suspension at room temperature by forcing solvent evaporation and surface cleaning for a few minutes at 200°C in low vacuum. The obtained specimens are about 50 cm^2 in size. All the ZnO nanostructure films are characterized by high porosity and high surface-to-volume ratios, which are generally basic requirements for the application in photocatalysis of gaseous species.
The samples have been characterised by scanning electron microscopy and tested for photocatalytic degradation activity of airborne pollutant using a stirred flow photoreactor irradiated with UV-A. The measurements were carried out using ethylbenzene as organic target pollutant at concentration level typically found in ambient conditions. The samples demonstrated a good photocatalytic activity in the degradation of ethylbenzene in air.

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