# SYNTHESIS AND LUMINESCENCE PROPERTIES OF SEMICONDUCTING OXIDE NANOSTRUCTURES

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Binary semiconductor oxides, such as ZnO, $SnO_2$, $Ga_2O_3$, have attracted high interest due to their specific optical and electrical properties. Most of them have applications as transparent conducting oxides and as gas sensors materials. Also, the synthesis and properties of nanoscale semiconductor oxides is very important for scientific and technological applications in the nanotechnology field [1]. One widely used method to obtain one-dimensional oxide nanostructures is thermal evaporation and different kind of morphologies have been recently obtained in semiconductor oxides, (eg. $SnO_2$ [2] and $Ga_2O_3$ [3]) and other semiconductor compounds CdTe [4]. In this work, we present some of the nanostructures obtained of $Ga_2O_3$, ZnO, $TiO_2$ and $GeO_2$ by a vapor-solid process during sintering treatments. Morphology and luminescence of the nanostructures have been investigated by scanning electron microscopy (SEM) and cathodoluminescence (CL) in the SEM respectively.

The starting materials were commercial powders of several semiconductor oxides ($Ga_2O_3$ , ZnO, $TiO_2$ and $GeO_2$). The powders were compacted under compressive load to form disk shaped samples of about 7 mm diameter and 2 mm thickness. The synthesis of the nanostructures on the surface samples is based on thermal evaporation of oxide powders, which act as source and as substrate, under controlled conditions without the presence of catalyst. The growth parameters, which depend on the material, are the furnace temperature, the Ar flowing rate and time..

A selection of SEM images of the nanostructures obtained in these semiconductor oxides are shown in Fig.1. $Ga_2O_3$ powders led after the treatment to the formation of sheets and nanowires with transversal dimensions of 10-100 nm (Fig.1a). The structures obtained from ZnO are either nano-rods and needles that in many cases join together forming the wall of a tubular structure, or nanocombs as shown in figure 1b. Nanobelts and bundles of nanoneedles of $GeO_2$ have been obtained after a treatment at 1100 ºC for 24 hours (Fig. 1c). In the case of $TiO_2$, terraces with rectangular shape of decreasing size are formed. On the top of some of them, rods with rectangular cross-section emerge (Fig. 1d).

The luminescence properties of these nanostructures have been studied by the excitation with an electron beam, which enable us to achieve high spatial resolution. In the case of $Ga_2O_3$ an intense new red band at 1.73 eV from the sheets and nanowires with a complex structure is detected. In ZnO, the CL mapping reveals that the inner part of the tubes presents higher luminescence than the outer wall. CL spectra from the inner and outer surfaces of the tube show that the deep level band, in particular the green emission at about 2.38 eV, dominates the spectrum from the inner wall of the tube. In the normalized spectra of $TiO_2$ one can observe that in samples sintered during 30 hours a new emission at 1.8 eV appear associated to the crystal growth, meanwhile the dominant emission due to the titanium interstitials at 1.5 eV is quenched.

## References:

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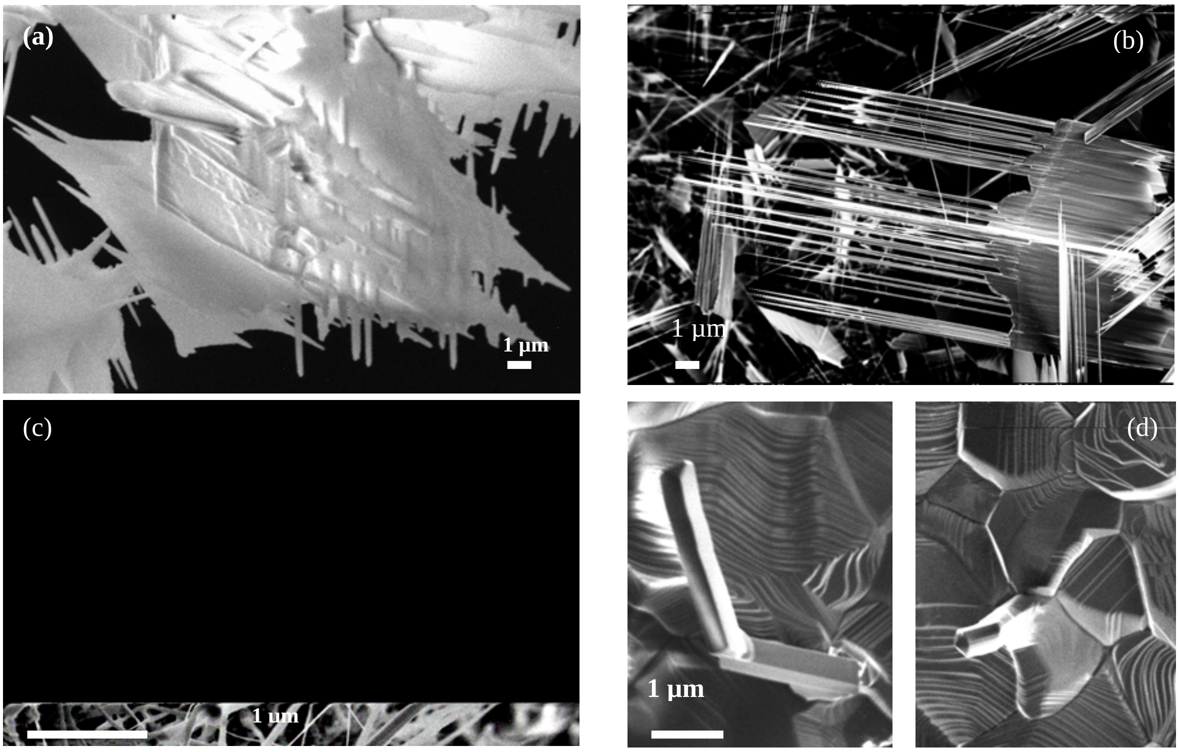
## Figures:

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