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Complex structure-properties relationships of luminescent In_2ZnkO_{3+k} materials

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Abstract

Tin indium oxides (ITO) are the transparent conductor oxides (TCO) that currently have the best properties. However, the shortage of Indium and, therefore, its high cost make it necessary to search for new TCO materials, which are consolidated as more economically viable alternatives. In this sense, the use ZnO, a cheap, abundant and non-toxic, with a resistivity comparable to that of ITOs. In this sense, zinc oxides doped with indium have been studied to improve optoelectronic properties.

Based on these considerations, several terms of the homologous series In2ZnkO3+k were prepared, with an exhaustive control of the synthesis conditions. The structural and microstructural characterization has allowed us to establish the relationship between the structure and the properties of the materials. The main challenges is to elucidate the origin of the modulation that occurs within the structural blocks of In/ZnO through the use of microscopic techniques with atomic resolution. Only in higher terms, disorderly intercreases between different members was observed. A displacement modulation in the homologous series structures for k> 6, according to a sinusoidal function in the basal plane and parallel to the c direction was observed by corrected aberration HRTEM. This modulation becomes compositional by doping the materials with other trivalent metal cations.

In the cathodoluminescence spectra a main, wide and complex band between 1.5 and 2 eV is observed, whose intensity increases markedly with k, possibly related to the presence of In3+ in interstitial positions of the trigonal bipyramid. A second band of interest for k = 3-7 terms, centered at ~ 2.4 eV whose origin would be related to the formation of the ternary is observed. These results seem to indicate that the luminescent response can be regulated depending on the composition of the materials, in order to understand the luminescent behavior and explore further technological applications of these materials.

Biography

Julio Ramirez-Castellanos is expertise in synthesis and structural/microstructural characterizations of new functional inorganic materials by high-resolution electron microscopy. His acquired a high research experience working at different international laboratories (Laboratoire De Cristallograhie (C.N.R.S.), Grenoble -FR-; Physics Department, Warwick University, Coventry –UK-; Structural Chemistry Department, Arrhenius Laboratory, Stockholm – SV-; National Institute For Materials Science (NIMS), (Tsukuba); Applied Physics Institute (Engineering Department), Tsukuba University – JP-. Currently, he is professor at Complutense University, Madrid. He is co-author of more than 100 reviewed scientific publications, four invention patents, and more than 100 communications to international conferences.

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