TEM investigation of AlN-Cu(O) with variable amounts of copper

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Some nitrides can have a good potential for photocatalytic applications, notably for antibacterial applications. AlN combined with copper could be one of those. The action of photocatalytic materials being conditioned by the value and electrochemical positions of electronic bands, it is necessary to start by specifying precisely the nature of composing phases of the nitrides after their synthesis.

Although recent theoretical calculations [1] (using ab initio DFT –Density Funtion Theory- and thermodynamics) can predict the stable and metastable routes of bi-metal nitrides on high ranges of composition, nothing can replace the microscopic observation of materials experimentally synthesized by an out of balance technique such as reactive magnetron sputtering.

AlN-Cu(O) material was prepared under the shape of thin films by D.C. -Direct Current- reactive magnetron sputtering under synthesis conditions chosen for facilitating film nanostructuration. The progressive addition of a third element to the binary nitride AlN could either lead to solid solution AlCuN or to a material composed of AlN and Cu rich phases. Whereas, XRD –X-ray Diffraction- was systematically performed for preliminary checking, TEM-Transmission Electron Microscopy- investigation is an essential and ideal step to discriminate the actual microstructure of the films and to position the experimental synthesis route towards the limit of solubility of copper in the nitride.

Electron diffraction patterns exploited through collection of rotational signals allowed the use of EVA software classically used by X-ray Diffraction experimentators to confront diffraction data to ICDD -International Center for diffraction Data- database. This work lead to the identification of phases. Chemical localization of copper could be detected by chemical mapping (STEM-EDS: 4DSTEM-ScanningTEM-), and crystallized zones could be tracked by diffraction and subsequent filtering (dynamical dark fields or numerical ones thanks to FFT –Fast Fourier Transform- of HR-High Resolution-TEM images).

The modification of the microstructure (change of nature of phases, their chemistry, crystalline structure, changes of morphology…) will be given as a function of the amount of copper used to elaborate the samples.

Keywords:

Nanostructure, morphology, AlN, copper, cermet

Reference:

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