ZnO nanostructures realized at different laser wavelengths and oxygen pressures

Anna Paola Caricato[1] , Maurizio Martino[1] , Daniele Valerini[1] , Francesco Romano [1] , Mauro Lomascolo[2]

[1]Dipartimento di Fisica, Università del Salento, Italy

[2]CNR-IMM Lecce

Nanostructured zinc oxide (ZnO) attracted great attention over the recent years because of its interesting properties, which make this kind of material particularly appealing for a wide range of applications (Ohmic contacts, Schottky contacts, LEDs, LASERs, transparent FETs, photodetectors, solar cells). Indeed ZnO, as bulk or thin film, is a very attractive material thanks to its features, like wide band gap, large exciton binding energy, chemical stability, biocompatibility, piezoelectricity, nonlinear optical effects and radiation hardness. When passing from bulk material to nanostructures, the interest is highly enhanced, since the properties coming from the reduced dimensionality of nanostructures add to the intrinsic ZnO properties. Furthermore, the intense studies in this research field are promoted by the possibility to realize a huge variety of ZnO nanostructures, such as dots, wires, rods, tetrapods, belts, tubes, needles, hierarchical structures and so on.

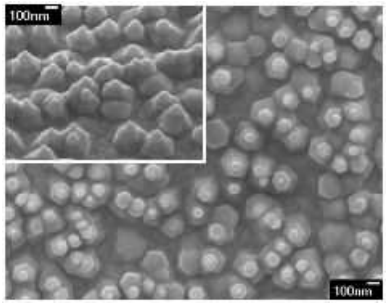

Figure 1. SEM-FEG mucrograph of ZnO nanopyramids deposited with ArF at 5 Pa of Oxygen.

Laser ablation is a powerful technique for the deposition of ZnO nanostructures. In fact, depending on the deposition parameters, like laser wavelength, substrate temperature, oxygen background pressure, nanostructured films with different morphologies can be obtained. We have demonstrated the growth of different ZnO nanostructures, such as columns, pencils, hexagonal pyramids, hexagonal hierarchical structures, as well as smooth and rough films, by means of excimer pulsed laser deposition (PLD), without the use of any catalyst. The substrate temperature was varied from 500 ?C to 700 ?C, at oxygen background pressures of 1, 5, 50 and 100 Pa. Moreover, very different film morphologies were observed when different laser wavelengths (248 nm or 193 nm) were used to ablate the bulk ZnO target. Photoluminescence and X-ray diffraction measurements revealed the good quality of the samples, in particular of those deposited using the ArF laser. The technological applications of these films, as gas sensors, have been successfully tested.