Growth and characterization of Zr doped ZnO structures on femtosecond laser induced periodic structures on different substrates.

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Abstract

Doped ZnO nanostructures have been widely investigated for their electrical and optical properties. It is one of the most used transparent conducting oxide (TCO) with low resistivity ($\leq 10{-}3\Omega cm$), high transparency (>80%) and high carrier concentration ($\geq 1020 cm{-}3$). Doping with Zr is proposed because of the similar ionic size of Zr4+ and Zn2+. That means the lattice distortions are minimized while the thermal and the chemical stability are improved being a promising alternative for high temperature working devices [1]. Furthermore, ZnO:Zr has shown enhanced photocatalytic properties [2]. In this work, Zr doped ZnO structures have been grown on different oriented Silicon substrates by a vapour-solid method under an Argon flux as is shown in Figure 1a. Mixtures of ZnS and ZrO2 in different percentages were used as precursors. Silicon <100> and <111> substrates have been also irradiated under certain conditions by a femtosecond laser operating at 1030nm with a pulse duration of 340 fs (Figure 1b). The irradiation of the substrates generates laser periodic surface structures (LIPSS) which depending on the irradiation condition could be amorphous or ablative structures [3]. The influence of the processed surface in the growth has been studied according to different parameters as the thermal treatment duration, percentage of doping, type of induced LIPSS and substrate orientation among others. Scanning Electron Microscopy has been used to analyze the morphology of the structures and Photoluminescence measurements provide information about the luminescence properties and the amount of defects in the structure giving a hint about the influence of the different parameters used in the growing process.

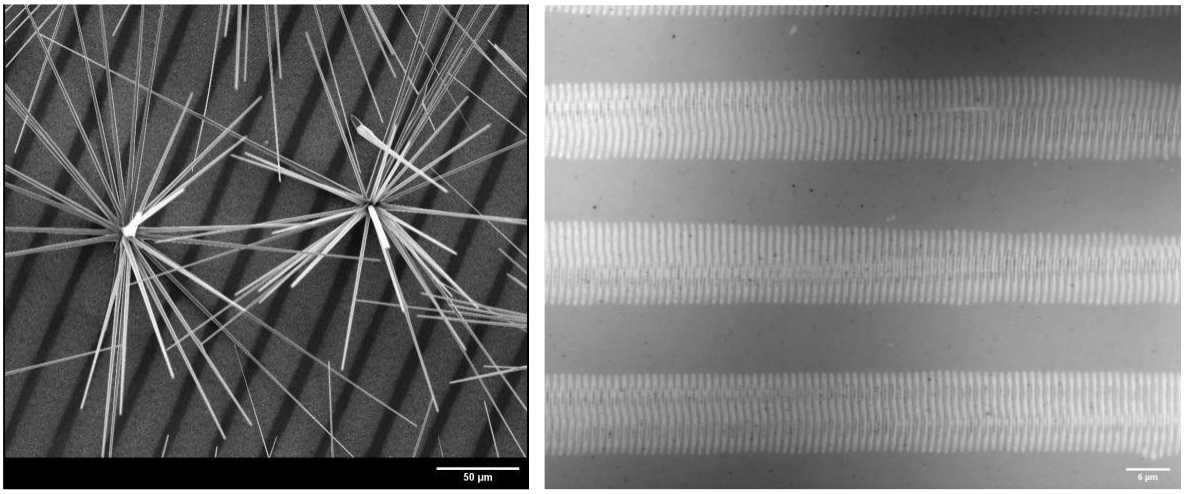

Figure 1. a) SEM image of the Zr doped ZnO structures growth on irradiated silicon substrate. b) Optical image of amorphous LIPSS in silicon <100>

References

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