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Numerical Analysis Receiving/Transmitting Mechanisms of ZnO/Ag Nanoantennas

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The fabrication, characterization and numerical analysis receiving/transmitting mechanisms of ZnO/Ag nanoantenas are very important nowadays, because it is in the group II–VI metal oxide semiconductor with a wide direct band gap [1]. Semiconductor nanostructures are desirable for the modern electronics, nanophotonics, quantum circuitry, plasmonics and energy conversion applications as well as for fundamental science. Specially, in nanophotonics and plasmonics, optical nanoantennas can reduce the breach between photons and semiconductor emitters or detectors in nanoscale. Electrical and optical characteristics of ZnO films are pretty similar like GaN, ZnS, and compound semiconductors, and also because this material has different applications such as solid-state light sources and detectors in the blue and UV spectral range [2-3]. For applications in electronics and optics field, ZnO has interesting properties such as magnetic, piezoelectric, and semiconductor. It has a high electrical conductivity and a high optical gain at ambient temperature. In consequence by these properties, thin films ZnO has found numerous potential applications in fields such as, light emitting diodes, most gas sensors, and solar cells. For example, in the ref. [4] was reported the crystalline orientation analysis at the ZnO/Ag interface, where ZnO rods grown on lateral faces of the pentagonal cross sectional area of silver nanowires were assembled in a hierarchical nanoantenna. This kind of nanoantenna is a promising alternative of plasmonic rf-nanoantennas for engineering light emission because of their low-loss nature in the spectrum [5-7].

In this paper, the numerical analysis receiving/transmitting mechanisms of ZnO/Ag nanoantenas was carried out. In this case, a Yagi-Uda, with 11 elements, type nanoantenna was used to simulate the radiation patterns from 1-5 GHz. In the figure 1, we can see the SEM images of the ZnO thin films (a) and ZnO/Ag hierarchical nanoantennas (b), reported in the ref. [4], where the pentagon geometry can be seen. In the figure 2, we can see the optimized antenna pattern at the design frequency at 5 GHz (a), and to obtain a better insight into the behavior in the two orthogonal planes, we also plotted the normalized magnitude of the electric field in the E and H-planes, i.e. azimuth = 0 (b) and 90 (c) deg, respectively. The results show that the nanoantennas might be capable of transmitting and/or receiving electromagnetic waves when stimulated with a modulated RF signal, especially at high frequency signals.

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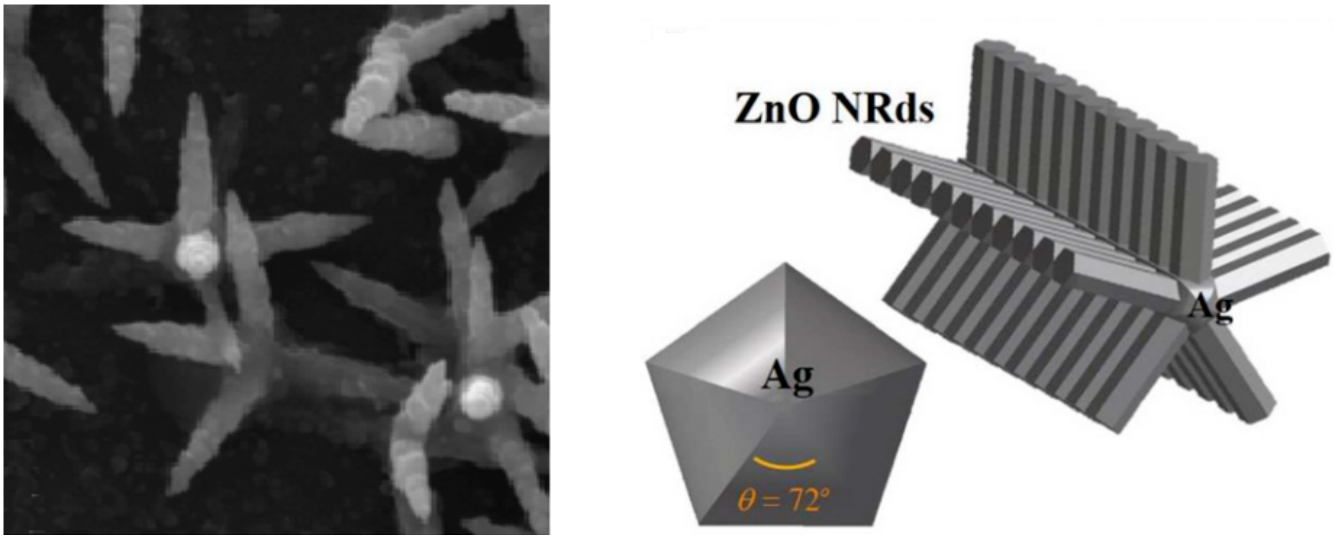
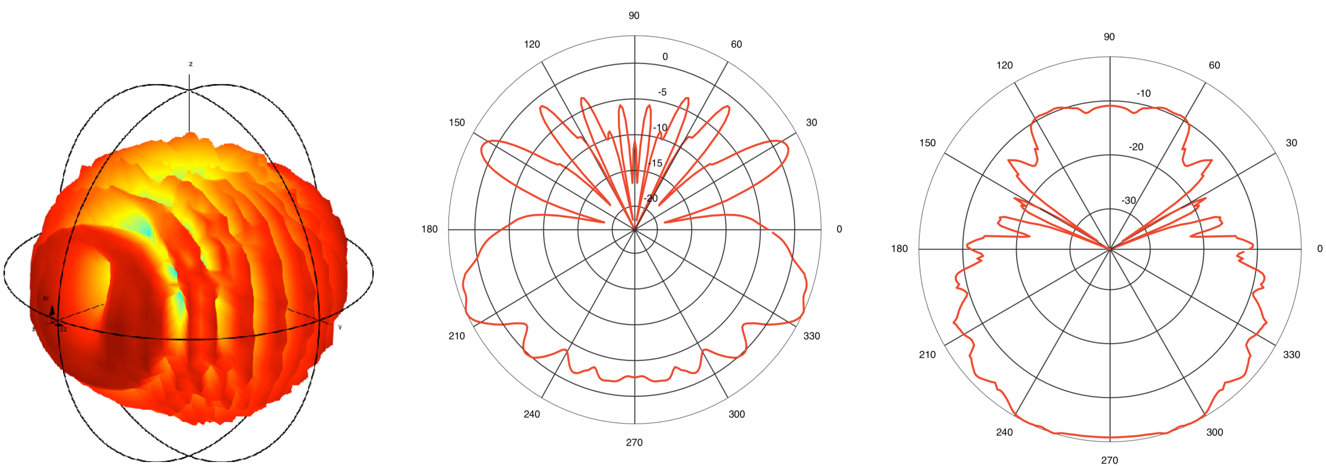


(a) (b)

Figure 1. SEM photos of the samples surfaces of ZnO thin films (a) and ZnO/Ag hierarchical nanoantennas (b).



(a) (b) (c)

Figure 2. Yagi-Uda antenna 3D radiation pattern at the frequency 5 GHz (a). The normalized magnitude of the electric field in the E and H-planes, azimuth = 0 (b) and 90 (c) deg.

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