Nanooptics and nanophotonics

Delayed luminescence of zinc oxide nanorods arrays

B.R. Ilyassov, N. Kh. Ibrayev, D.A. Afanasyev

E.A. Buketov Karaganda State University, Institute of Molecular Nanophotonics, Universitetskaya Street 28, Karaganda-100028, Kazakhstan
E-mail: email.of. baurdinho@mail.ru

ZnO thin films were synthesized by a hydrothermal method on quartz substrates [1]. The morphology and crystal structure of the obtained films were studied with the scanning electron microscope and an X-ray diffractometer. Thin films are zinc oxide (ZnO) nanorods arrays. They are predominantly oriented along the crystallographic axis 002 perpendicular to the substrate.

The absorption and luminescence spectra of zinc oxide nanorods arrays were measured at room temperature. A small peak was observed on the fundamental band edge optical absorption in ZnO films.

The luminescence spectra of nanorods arrays consist of short-wavelength band with a maximum at 380 nm and a broad band in the visible region with a maximum at 610 nm. Short-wave or edge luminescence with a maximum of 380 nm has excitonic nature [2]. Nature of long-wavelength luminescence has yet discussed, in spite of the huge amount of research [3]. The luminescence kinetics was measured in the nanosecond and microsecond time range. Kinetics of luminescence damping with a maximum 380 nm was observed in the nanosecond time range with decay time about 1 ns. Decay luminescence kinetics at 610 nm was observed in the microsecond time range. The total kinetic curves of ZnO films have a non-exponential type. Decay time τ_2 during which the intensity of delayed luminescence halved is about 5 μs at room temperature. With decreasing temperature, the intensity and duration of the delayed luminescence increase and when the boiling temperature of liquid nitrogen decay time τ_2 is about 90 μs. This is due temperature ignition of luminescence.

1. *S. Baruah, J. Dutta, J.* Hydrothermal growth of ZnO nanostructures //Sci. Technol. Adv. Mater.-2009.-10.-P. 013001 -18.Technol. Adv. Mater., 2009, 10, 013001 -18
2. B. K. Meyer, H. Alves, D. M. Hofmann, et al. Bound exciton and donor–acceptor pair recombinations in ZnO //J. Phys. Stat. Sol. (B), 2004.-**241**.-P. 231-260.
3. P. A. Rodnyi, I. V. Khodyuk. Optical and Luminescence Properties of Zinc Oxide // J. opt. spectrosc.-2011.-**111**.-P. 776-785