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Excitonic states and carrier recombination in ZnO quantum dots
VLADIMIR A. FONOBEROV, ALEXANDER A. BALANDIN, Nano-Device Laboratory (http://ndl.ee.ucr.edu), Dept. of Electrical Engineering, University of California, Riverside, CA 92521 — ZnO quantum dots and related Mn-doped ZnO/ZnMgO nanostructures have recently attracted significant attention as a new nano-engineered functional material for spintronic and optoelectronic applications. We have studied the carrier recombination processes in ZnO-based quantum dots both theoretically and using the photoluminescence (PL) spectroscopy in the temperature range T=8.5 K - 300 K [1]. The obtained experimental data suggest that below T = 70 K, the ultraviolet PL in ZnO quantum dots originates from recombination of the donor-acceptor pairs, while above T = 70 K it is due to recombination of the acceptor-bound excitons. The latter is in agreement with our theoretical predictions [2]. No strong inhomogeneous broadening has been observed in ultraviolet PL from ZnO quantum dots. Our results shed new light on the carrier-recombination processes in ZnO quantum dots and can be used for the ZnO nanostructure optimization for the proposed applications. The authors acknowledge the support of MARCO and its Functional Engineered Nano Architectonics (FENA) Focus Center.
[1] V.A. Fonoberov, K.A. Alim, A.A. Balandin et al., Phys. Rev. B, submitted (2005); [2] V.A. Fonoberov and A.A. Balandin, Phys. Rev. B 70, 195410 (2004); Appl. Phys. Lett. 85, 5971 (2004).

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