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Light emission from electrically stressed ZnO nanorods

LUCA LUCERA, LHACENE ADNANE, KADIR CIL, VENKATA MANTHINA, ALEXANDER AGRIOS, HELENA SILVA, ALI GOKIRMAK, University of Connecticut — Zinc oxide (ZnO) nanorods were grown on various substrates by a chemical growth process based on a ZnO seed solution, and starting from Zinc acetate (ZnAc) material. The nanorods were grown on insulating silicon (low doped) and oxidized silicon substrates, and also over patterned conducting (highly-doped) nanocrystalline silicon microwires. When high voltage is applied directly to the ZnO film using tungsten needles ($\sim$ 50-60 V across $\sim$ 5-10 μm), high intensity blue and white light emission is observed, both in air and under high vacuum (10^{-4} - 10^{-5} Torr). Blue light appears as broad bright flashes covering a large area whereas white light is more localized and appears to come from individual nanostructures. The results suggest a combination of electroluminescence and photoluminescence processes that take place after an electrical breakdown (possibly across individual ZnO nanorods) that is observed as an exponential increase in current. Percolative conduction and light paths are also observed during the measurements. Measurements of the ZnO films of rods on conducting silicon substrate give more repeatable results, likely due to the higher probability of conducting paths between the two probes. The electrical stress results in significant self-heating and modification of the ZnO nanostructures and the contacts.

[1] Greene L. E. et al. Solution-Grown Zinc oxide nanowires. Innorganic Chemistry. Vol 45. 7535-7543. (2006)

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