Abstract for an Invited Paper
for the NWS07 Meeting of
The American Physical Society

Zinc oxide - a material for energy applications[1]

MATTHEW MCCLUSKEY, WSU

Zinc oxide (ZnO) is a wide-band-gap semiconductor that has attracted resurgent interest as an electronic material for a range of applications. The efficiency of the emission is higher than more conventional materials such as GaN, making ZnO a strong candidate for energy-efficient white lighting. Another major advantage of ZnO is the fact that, in contrast to GaN, large single crystals can be grown. ZnO has been used as a transparent conductor in solar cells, and is a preferred material in transparent transistors, "invisible" devices which could be very useful in products such as liquid-crystal displays. In addition to optoelectronic and electronic devices, ZnO has emerged as a potentially important material for spintronic applications. Despite its numerous advantages and potential applications, ZnO suffers from a relatively high level of donor defects. These compensating impurities prevent p- type doping, which is essential for practical applications. In our work, we have focused on hydrogen donors in bulk ZnO, combining IR spectroscopy with electrical measurements. As dimensions approach the nano-scale, the vastly increased surface-to-volume ratio leads to interesting phenomena. At moderate annealing temperatures (350 C), hydrogen permeates nanoparticles, resulting in a dramatic increase in electrical conductivity, free-carrier absorption, and infrared reflectivity. These results could be relevant to hydrogen sensing and storage applications.

[1]In collaboration with Slade Jokela, WSU and Win Maw Hlaing Oo.