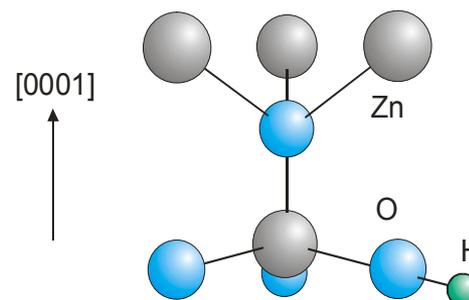


Local vibrational modes of impurities in semiconductors

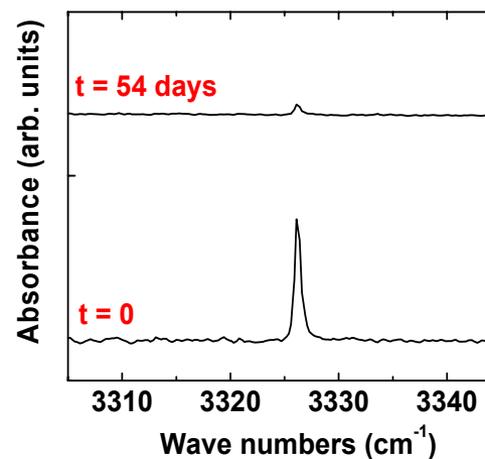
Matthew D. McCluskey, Washington State University, DMR-0203832

Zinc oxide (ZnO) is a wide-band-gap semiconductor that has attracted tremendous interest as a blue light-emitting material, a substrate for GaN-based devices, and a transparent conductor for solar cells. As grown, ZnO is almost always *n* type. Recent theoretical work by Van de Walle [Phys. Rev. Lett. **85**, 1012 (2000)] predicted that hydrogen impurities act as shallow donors. To determine the structure of these donors, we used infrared (IR) spectroscopy to measure the local vibrational modes of ZnO annealed in hydrogen. The results are consistent with hydrogen in an anti-bonding orientation.

Appl. Phys. Lett. **81**, 3807-9 (2002).



Oxygen-hydrogen (O-H) complex in ZnO. Hydrogen is shown in the anti-bonding orientation.



IR spectrum of O-H complexes at liquid-helium temperatures. After several weeks, the peak disappears, suggesting that the complex is unstable.

Local vibrational modes of impurities in semiconductors

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Education:

This NSF-sponsored research has supported two undergraduates (John Singleton and Lance Culnane), three Ph.D. students (Slade Jokela, Win Maw Hliang Oo, and Kirill Zhuravlev), and one visiting scientist (Leonardo Hsu). This grant has also sponsored the development of upper-division solid state lecture demonstrations.



Materials Science Ph.D. student Slade Jokela.

Outreach:

The PI has organized visits by kids from the Washington State University Children's Center (ages 2-10). He was also a mentor for a high school senior project on building a Tesla Coil.



The PI demonstrating the effect of liquid nitrogen on a balloon to kids from the WSU day care.