Local vibrational mode spectroscopy of hydrogen in compound semiconductors

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Abstract:

Infrared (IR) and Raman spectroscopy are useful techniques for characterizing hydrogen-related defects in semiconductors. This talk will focus on hydrogen in compound semiconductors such as AlSb, GaAs, GaN, InP, and ZnO. In most compound semiconductors studied to date, hydrogen forms neutral complexes with donors or acceptors. In GaN:Mg grown by metalorganic chemical vapor deposition, for example, hydrogen forms pairs with Mg acceptors so that the semiconductors is semi-insulating as grown. In ZnO, however, theoretical and experimental work has shown that hydrogen is a shallow donor. We have observed hydrogen local vibrational modes in ZnO annealed in hydrogen gas, allowing us to speculate as to the structure of the hydrogen complex. The use of high pressures in conjunction with IR spectroscopy may provide a means for distinguishing between similar configurations. In GaN:Mg,H, the local vibrational mode exhibits a small shift with pressure. By comparing this shift with the predictions of ab initio calculations, we can rule out the bond-centered (BC) configuration. Possibilities for future studies involving high-pressure spectroscopy will be discussed.