

Point defects in semiconductors for quantum technologies

Chris G. Van de Walle

Materials Department, University of California, Santa Barbara, CA 93106-5050, USA
vandewalle@mrl.ucsb.edu

Quantum technologies have become a top research priority. However, the underlying hardware still requires major development. Point defects in semiconductors and insulators play a key role. On the one hand, they can be detrimental since they cause decoherence. On the other hand, they can act as functional centers, providing a platform that combines the environmental isolation necessary to maintain the coherence of quantum states with the ability to perform electrical and optical manipulation. I will discuss first-principles analyses of a prototype quantum defect, the nitrogen-vacancy (NV) center in diamond, that elucidate its properties and form a foundation for predicting which centers in other materials might exhibit similarly favorable properties. Building on the general methodology for performing point-defect calculations, we have developed the capability to predict transition energies, lineshapes, and radiative and nonradiative rates. These developments enable us to analyze, identify, and predict quantum point defects, as will be illustrated with examples for a number of materials.

Bio:

Chris Van de Walle is a Distinguished Professor of Materials at the University of California, Santa Barbara and holds the Herbert Kroemer Endowed Chair in Materials Science. Prior to joining UCSB in 2004, he was a Principal Scientist at the Xerox Palo Alto Research Center (PARC). He received his Ph.D. in Electrical Engineering from Stanford University in 1986, and was a postdoctoral scientist at IBM Yorktown Heights (1986-1988) and a Senior Member of Research Staff at Philips Laboratories in Briarcliff Manor (1988-1991). Van de Walle develops and employs first-principles computational techniques to model the structure and behavior of materials. He has published over 450 research papers and holds 24 patents. Van de Walle is a Member of the National Academy of Engineering, a Fellow of the APS, AVS, AAAS, MRS, and IEEE, as well as the recipient of the David Adler Award from the APS, the Medard W. Welch Award from the AVS, the TMS John Bardeen Award, and the MRS Materials Theory Award.