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Optical spectroscopy of single impurity centers in semiconductors

SEBASTIEN FRANCOEUR, Nat. Renewable Energy Lab., J.F. KLEM, Sandia National Lab., A. MASCARENHAS, Nat. Renewable Energy Lab. — Using optical spectroscopy with diffraction limited spatial resolution, the possibility of measuring the luminescence from single impurity centers in a semiconductor is demonstrated. Selectively studying individual centers that are formed by two neighboring nitrogen atoms in GaAs makes it possible to unveil their otherwise concealed polarization anisotropy, analyze their selection rules, identify their particular configuration, map their spatial distribution, and demonstrate the presence of a diversity of local environments. Circumventing the limitation imposed by ensemble averaging and the ability to discriminate the individual electronic responses from discrete emitters provides an unprecedented perspective on the nanoscience of impurities.

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