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A Study of the Electronic Structure and the Effects of Oxygen on the Superconducting Properties of MgB_2 by Electron Energy Loss Spectroscopy JUAN C. IDROBO, SERDAR OGUT, University of Illinois at Chicago, TANER YILDIRIM, NIST Center for Neutron Research, NIGEL BROWNING, University of California Davis and Lawrence Berkeley National Laboratory —
The transport properties of MgB_2 have a strong dependence on the incorporation of impurities such as oxygen. Different phases of oxygen precipitates have been characterized and it has been found that the presence of oxygen in MgB_2 systematically changes the electronic structure of the boron atoms. Among the different phases of oxygen precipitates found in MgB_2, those forming coherent superlattice structures of MgB_2- MgB_xO_y were studied in detail by first principles calculations. This kind of precipitate has been reported to increase the upper critical fields and critical current density without decreasing the critical temperature of MgB_2. This effect is reflected by the low critical temperatures calculated for coherent oxygen precipitates with different concentrations of oxygen using density functional theory. These low critical temperatures explain the behavior of the oxygen precipitates as pinning centers and highlight the importance of oxygen on the superconducting properties of MgB_2. Additionally, due to the presence of two carrier species given by the B and Mg states in MgB_2, a low energy plasmon mode was theoretically proposed. This work presents the first experimental evidence of this plasmon mode, which has a quadratic dispersion, $\omega_p \propto q^2$.

Serdar Ogut
University of Illinois at Chicago

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