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Accession number:20123115295206 Title:Exciton Mott transition in Si revealed by terahertz spectroscopy Authors:Suzuki, Takeshi (1); Shimano, Ryo (1) Author affiliation:(1) Department of Physics, University of Tokyo, Tokyo 113-0033, Japan Corresponding author:Suzuki, T. Source title: Physical Review Letters Abbreviated source title: Phys Rev Lett Volume:109 Issue:4 Issue date:July 26, 2012 Publication year:2012 Article number:046402 Language:English ISSN:00319007 E-ISSN:10797114 CODEN:PRLTAO Document type: Journal article (JA) Publisher: American Physical Society, One Physics Ellipse, College Park, MD 20740-3844, United States

Abstract:We investigate the exciton Mott transition in Si by using optical pump and terahertz probe spectroscopy. The density-dependent exciton ionization ratio α is quantitatively evaluated from the analysis of dielectric function and conductivity spectra. The Mott density is clearly determined by the rapid increase in α as a function of electron-hole (e-h) pair density, which agrees well with the value expected from the random phase approximation theory. However, exciton is sustained in the high-density metallic region above the Mott density as manifested by the 1s-2p excitonic resonance that remains intact across the Mott density. Moreover, the charge carrier scattering rate is strongly enhanced slightly above the Mott density due to nonvanishing excitons, indicating the emergence of highly correlated metallic phase in the photoexcited e-h system. Concomitantly, the loss function spectra exhibit the signature of plasmon-exciton coupling, i.e., the existence of a new collective mode of charge density excitation combined with the excitonic polarization at the proximity of Mott density. © 2012 American Physical Society.

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