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NEBRASKA CENTER FOR MATERIALS AND NANOSCIENCE / NSF-MRSEC SEMINAR SERIES PRESENTS

MRSEC

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INFRARED AND RAMAN STUDY OF THE CHARGE-DENSITY-WAVE GROUND STATE

The question of the relationship between the effective dimensionality of a physical system and the symmetry of its ground state is an important issue in order to figure out the relevant mechanism driving materials into peculiar charge ordering. In this respect, the rare-earth polychalcogenides $R\mathrm{Te}_n$ (where R is the rare-earth element and n=2, 2.5, 3) have recently attracted great interest because of their low dimensionality. Among the $R\mathrm{Te}_{\mathrm{n}}$ families are members that variously host large commensurate distortions, ordered and disordered vacancy structures, and Fermi surface driven charge-density-wave (CDW). They supply furthermore a playground to study the interplay between CDW state, peculiar magnetic order and eventually pressure induced superconductivity. Optical spectroscopic methods (infrared reflectivity and Raman scattering) were applied as a function of both temperature and external pressure, in order to address the complete excitation spectrum in these CDW materials. We establish the energy scale of the single particle excitation across the CDW gap and find that the CDW collective state gaps a large portion of the Fermi surface. The CDW gap decreases upon compressing the lattice (both with chemical and applied pressure). The suppression of the CDW gap leads to a release of additional charge carriers, manifested by the shift of weight from the gap feature into the metallic component of the optical response. Furthermore based on the observation of a power law behavior in the optical conductivity, we suggest that interactions and Umklapp processes may play a roll in the onset of the CDW broken symmetry ground state. We discuss our optical conductivity at high frequencies with respect to predictions based on the Tomonaga-Luttinger liquid scenario. We will moreover present our Raman scattering experiments as a function of chemical and applied pressure, from where we get evidence for a coupling between the CDW condensate and the lattice vibrational modes.

Monday, June 23, 2008
201 Brace Lab
2:00 p.m.

Host:
Prof.
Mathias Schubert

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