Metal insulator transition

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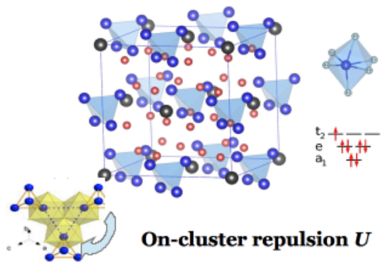
Our group is mainly interested in using **optical and Raman spectroscopy** to investigated vibrational properties and electrodynamics of strongly correlated, multiferroic materials.

Strongly correlated systems - Metal-insulator transition

Mott insulators represent a large class of materials with half-filled d or f orbitals that should be metallic according to conventional band theory, but are actually insulators. In these systems, the on-site electron-electron repulsion U, not included in the conventional band theory, leads to an insulating ground state when U is significantly larger than the half-bandwidth D. An interesting characteristic of Mott insulators is that external perturbations may provoke **insulator to metal transitions** (IMT).

For example, it occurs by the application of **chemical or physical pressure** which enhances the bandwidth. Similarly a deviation from half-filling caused by an **electronic doping** also induces an IMT. During the last quarter century, outstanding electronicproperties were discovered in the vicinity of such metal-insulator transitions : **superconductivity in copper oxides**, **molecular systems** -(BEDT-TTF)2 X and **iron chalcogenides, colossal magnetoresistance** in manganites or **thermoelectricity** with large figure of merit in different doped Mott insulators including cobaltites, ...



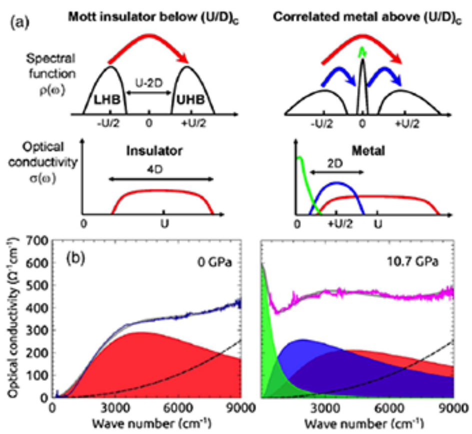


FIG. 2 (color online). (a) Schematic view of the evolution of the spectral function and of the optical conductivity in a Mott insulator and in a correlated metal on each side of a bandwidth-controlled metal-insulator transition (from Ref. [29]). (b) Usual Drude-Lorentz fit of the optical conductivity at 0 and 10.7 GPa. The dashed line corresponds to the pressure-independent high-frequencies contributions. The red area represents the broad midinfrared band at 0 GPa. The Drude peak and the two mid-infrared features at $\approx U/2$ and $\approx U$ at 10.7 GPa are shown by green, blue, and red areas, respectively. The thick (gray) solid lines correspond to the fit of the optical conductivity spectra. Fit parameters are listed in Ref. [44].

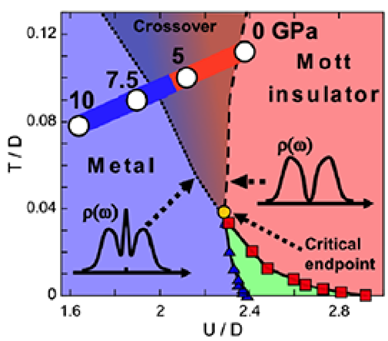


FIG. 4 (color online). Theoretical T/D, U/D phase diagram for a one-band Mott insulator predicted by the DMFT. Our data points (white circles) on $GaTa_4Se_8$ are positioned using $U = 0.55$ eV (see text) and the half-bandwidth D mentioned in Fig. 3. The colored line below the white circles recalls the behavior revealed by our optical conductivity data: Mott insulator regime (red part) below 6 GPa, followed by a progressive growth of low energy SW (blue part) at higher pressure.