ELECTRON-PHONON COUPLING IN BINARY MOLIBDATES

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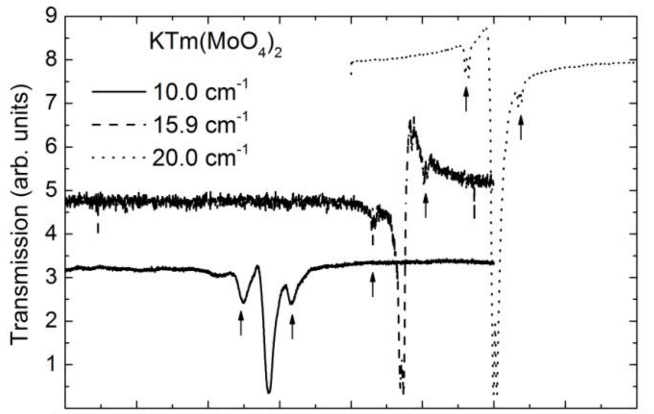
Dynamical non-linear systems are at the coalface of modern physics since most physical phenomena are inherently non-linear in nature. Non-linearity causes profound effects even in classical systems, the formation of solitons being one famous example.

Here we report the study of non-linear effects in binary molibdates. The characteristic feature of rare-earth compounds $MR(MoO_4)_2$ (M^+ is an alkali metal ion, R^{3+} is a rare-earth ion) is the strong coupling between the electronic excitations of the R^{3+} ions and phonons. Previous investigations show that the strength of electron-phonon coupling can be tuned by a magnetic field [1]. Such tunability is particularly important for the non-linear systems where a lack of control makes experimental investigations very challenging.

We investigate electron-phonon coupling by means of far infrared (FIR) and electron paramagnetic resonance (EPR) spectroscopies. FIR study performed in externally applied magnetic fields allowed us to determine energies of lattice vibrations and electronic excitations. We show that EPR spectra undergo significant modification when energies of microwave frequencies and lattice vibrations coincide. We argue that the effects observed are induced by strong coupling between electronic excitations and acoustic phonons.

Figure shows the EPR transmission spectra of the $KTm(MoO_4)_2$ at different frequencies. The magnetic field applied along the *c*-axis shifts the EPR transitions to high frequencies quite rapidly (g = 13.8) [2]. We show that EPR spectra undergo significant modification when energies of microwave frequencies change in respect to the energy of acoustic vibrations. The sidebands (shown by the arrows) are most developed at low frequencies and vanish when frequencies becomes higher than the limit frequency for the acoustic mode.



We show that such interaction between electronic excitation and acoustic phonon exhibit universal character and may significantly affect the magnetic properties of wide class of materials especially at high magnetic field.

[1] V. I. Kut'ko, Low Temp. Phys. **31**, 1-31 (2005).
[2] D. Kamenskyi,S. Poperezhai, P. Gogoi, H. Engelkamp, J. C. Maan, J. Wosnitza, and V. Kut'ko, Phys. Rev. B, **89**, 014410 (2014).