Raman scattering of hBN encapsulated $MoTe_2$

M. Grzeszczyk[1], M. R. Molas[1], M. Bartoš[2], K. Nogajewski[1], T. Taniguchi[3], K. Watanabe[3], M. Potemski[1,2], A. Babiński[1]

[1] *Faculty of Physics, University of Warsaw, Warsaw, Poland*
[2] *Laboratoire National des Champs Magnétiques Intenses, Grenoble, France*
[3] *National Institute for Materials Science, Tsukuba, Ibaraki, Japan*

In the fast evolving semiconductor studies, two-dimensional materials have been prevalent for several years. In addition, rapid advances in mechanical exfoliation techniques have contributed to increased interest in layered materials, including transition metal dichalcogenides (TMDs).

The effect of temperature (5K to 300K) on the Raman scattering due to out-of-plane vibrations in bilayer (2 L) and trilayer (3 L) $MoTe_2$ is investigated. Previously we reported on quenching of the out-of-plane modes in the Raman scattering in thin $MoTe_2$ layers, which was explained in terms of destructive interference of the resonant- and the non-resonant contributions to the Raman scattering. [1] This reasoning is further extended to reproducing the measurements for encapsulated samples of the same crystal in order to eliminate any surface effects. As it can be seen on Figure 1 (a) the dip of intensity of the A_{1g} mode is narrower and shifted towards higher temperatures with respect to previously measured pristine flake. This observation is explained with the change of dielectric environment, such effects was reported for all encapsulated TMD-based samples.

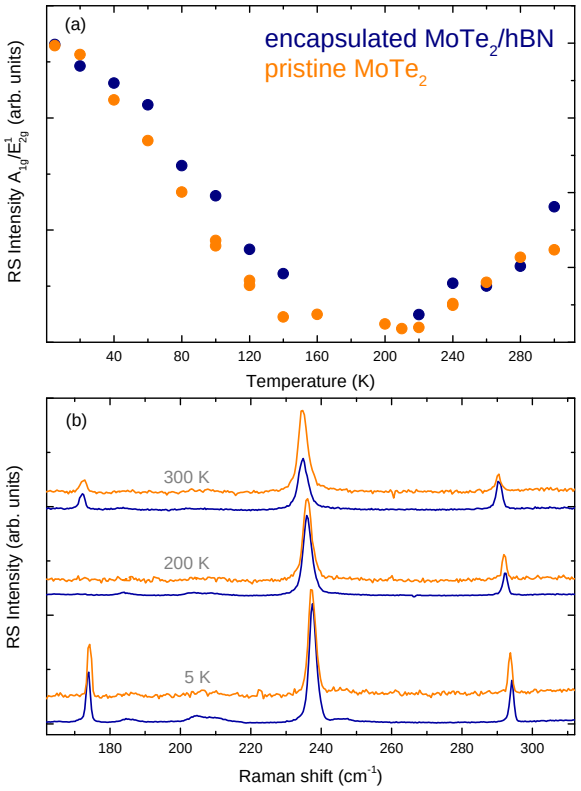

Figure 1: (a) Temperature dependence of the relative intensities of the A_{1g} peaks in the RS spectra of 2 L $MoTe_2$. (b) RS spectra excited with 1.96 eV measured at selected temperatures.

This report aims to understand the influence of the environment on properties of the two-dimensional TMD layers, which could lead to better understanding the processes of crystal lattice excitation and resonant effects in such materials.

[1] K. Gołasa et al., *MRS Advances* **2**, 1539 (2017)