The effect of temperature and excitation energy on Raman scattering in bulk HfS_2

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Raman scattering (RS) in bulk hafnium disulfide (HfS_2) is investigated as a function of temperature and excitation of several laser energies (fig. 1). The low-temperature quenching of ω_1 (134 cm^{-1}) and the emergence of a new mode at approx. 184 cm^{-1}, labeled Z, is reported (fig. 1.a). An unexpected blue-shift of the main Raman-active modes (A_{1g} and E_g) as temperature increases, was observed (fig. 1.b). The excitation-dependent RS is reported. The apparent quenching of the A_{1g} mode at T=5 K and of the E_g mode at T=300 K in the RS spectrum excited with 3.06 eV excitation is also observed. We discuss the results in the context of possible resonant character of light-phonon interactions. Analyzed is also a possible effect of the iodine molecules intercalated in the van der Waals gaps between neighboring HfS_2 layers, which inevitably result from the growth procedure.

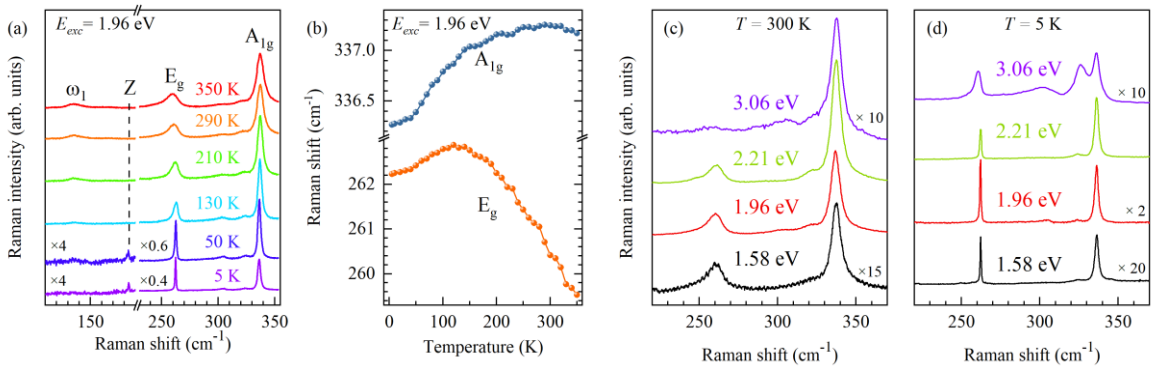

Fig. 1 (a) The temperature evolution of RS spectra measured on HfS2 bulk under excitation of E_{exc}=1.96 eV. For temperatures lower than 100 K a new mode, called here Z, has been observed and the quenching of ω_1. (b) Temperature evolution of the Raman shift of the A_{1g} and E_g modes under excitation of E_{exc}=1.96 eV. The Raman scattering spectra measured on Hf_2 bulk at (c) T =300 K and (d) T =5 K under a series of different excitation energies, indicated in the Figure.