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Hydride Superconductors, a path to room temperature superconductivity

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The discovery of a superconducting phase in sulfur hydride under high pressure with a critical temperature above 200 K by Drozdov et al. [1] has provided a new impetus to the search for even higher Tc. The observation of a sharp drop in resistance to zero at Tc, its downward shift with magnetic field and a Meissner effect confirm superconductivity but the mechanism involved remains to be determined. Using the AILES beam line at Soleil, we provided a first optical spectroscopy study of this new superconductor[2]. Experimental results for the optical reflectivity of H3S, under high pressure, were compared with theoretical calculations based on Eliashberg theory using DFT results for the electron-phonon spectral density. One significant features stands out: a band with a depressed reflectance in the superconducting state in the region from 450 meV to 600 meV. The shape, magnitude, and energy dependence of this band at 150 K agrees with our calculations. This is strong evidence of a conventional electron-phonon mechanism. Also, this band provides a tool for a non-invasive probe of superconductivity[3].

1. A.P. Drozdov, M.I. Eremets, I.A. Troyan, V. Ksenofontov, and S.I. Shylin, Nature 525, 73–76 (2015).
2. F.Capitani, B. Langerome, J.-B. Brubach, P. Roy, A. Drozdov, M.I. Eremets, E. J. Nicol, J. P. Carbotte, and T. Timusk, Nature Physics 15, 859 (2017)
3. J.P. Carbotte, E.J. Nicol, and T. Timusk, Physical Review Letters, 121, 047002 (2018)

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