Temperature dependence of the direct band gap of InSb from 80 to 700 K

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In this undergraduate student presentation, we describe measurements of the dielectric function of bulk InSb near the direct band gap using Fourier-transform infrared (FTIR) spectroscopic ellipsometry from 80 to 800 K in an ultra-high vacuum (UHV) cryostat with diamond windows. Indium antimonide (InSb) is the zinc blende compound semiconductor with the smallest direct band gap (E_0 = 0.18 eV at room temperature) due its heavy elements and the large resulting spin-orbit splitting and Darwin shifts. It also has a low melting point of 800 K. Previously, the band gap of InSb has mostly been measured optically up to room temperature [1] and estimated from Hall effect measurements of the effective mass up to 470 K. Ellipsometry measurements of the direct gap of InSb at 300 K have been described in [2]. Calculations indicate that InSb should undergo a topological phase transition from semiconductor to semi-metal (and topological insulator) at 600 K. It is interesting to see in the data if this transition occurs below the melting point of InSb.

(a) **(b)**

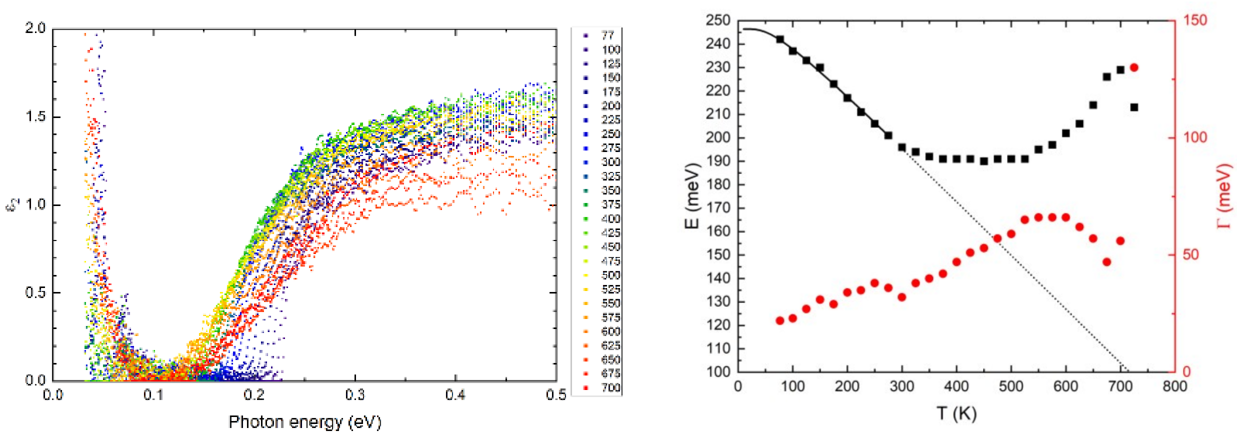

Figure 1: **(a)** Imaginary part of the dielectric function at temperature from 80 to 700 K. The real part of ε is Kramers-Kronig consistent. **(b)** Energy and broadening of the direct gap of InSb versus temperature.

References:

[1] C. L. Littler and D. G. Seiler, Appl. Phys. Lett. **46**, 986 (1985).
[2] S. T. Schaefer, S. Gao, P. T. Webster, R. R. Kosireddy, and S. R. Johnson, J. Appl. Phys. **127**, 165705 (2020).