Reflectivity measurements

The polarized reflectivity $R(\omega)$ with $E \parallel a$-axis and $E \parallel c$-axis was measured at a near-normal angle of incidence using a Bruker VERTEX 70v FTIR spectrometer. In order to accurately measure the absolute $R(\omega)$ of the sample, an in situ gold overcoating technique \cite{1} was employed. Data from 20 to 8000 cm$^{-1}$ were collected at 14 different temperatures from 300 down to 10 K on a shiny surface of ZrTe$_5$ in an ARS-Helitran cryostat. Since a Kramers-Kronig analysis requires a broad spectral range, the room temperature $R(\omega)$ in the near-infrared to ultraviolet range (4000 – 50000 cm$^{-1}$) was measured with a commercial ellipsometer (Woollam VASE).

Kramers-Kronig analysis

The real part of the optical conductivity $\sigma_1(\omega)$, which provides direct information about the charge dynamics, has been determined via a Kramers-Kronig analysis of $R(\omega)$ \cite{2}. Below the lowest measured frequency, we used a Hagen-Rubens function ($R = 1 - A\sqrt{\omega}$) for the low-frequency extrapolation. For the extrapolation on the high frequency side, we used the room temperature ellipsometry data and extended them assuming a constant reflectivity up to 12.5 eV that is followed by a free-electron ($\omega^{-4}$) response.

\[ \text{[1]} \quad \text{C. C. Homes, M. Reedyk, D. A. Cradles, and T. Timusk, Appl. Opt. 32, 2976 (1993).} \]
\[ \text{[2]} \quad \text{M. Dressel and G. Grüner, Electrodynamics of Solids (Cambridge University press, 2002).} \]