

Supplementary material for Temperature-driven Topological Phase Transition and Intermediate Dirac Semimetal Phase in ZrTe_5

B. Xu,^{1,*} L. X. Zhao,² P. Marsik,¹ E. Sheveleva,¹ F. Lyzwa,¹ Y. M. Dai,³ G. F. Chen,² X. G. Qiu,² and C. Bernhard¹

¹*University of Fribourg, Department of Physics and Fribourg Center for Nanomaterials,
Chemin du Musée 3, CH-1700 Fribourg, Switzerland*

²*Beijing National Laboratory for Condensed Matter Physics, Institute of Physics,
Chinese Academy of Sciences, P.O. Box 603, Beijing 100190, China*

³*Center for Superconducting Physics and Materials,*

National Laboratory of Solid State Microstructures and Department of Physics, Nanjing University, Nanjing 210093, China

Reflectivity measurements

The polarized reflectivity $R(\omega)$ with $\mathbf{E}\parallel a$ -axis and $\mathbf{E}\parallel c$ -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 [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-Helitrans 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 $R(\omega)$ [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 (ω^{-4}) response.

* bing.xu@unifr.ch

[1] C. C. Homes, M. Reedyk, D. A. Cradles, and T. Timusk, *Appl. Opt.* **32**, 2976 (1993).

[2] M. Dressel and G. Grüner, *Electrodynamics of Solids* (Cambridge University press, 2002).