# Crystal Orientation and Handedness of Chiral Tellurium by Chemical Etching and Polarized Raman Spectroscopy

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Abstract

The significant growth, development, and evolution of technologies such as optoelectronics and spintronics have always been accompanied by access to materials with specific and extraordinary properties. Among these materials, recently, chiral trigonal tellurium (Te) stands out since it exhibits electrical magneto-chiral anisotropy and spin polarization,[1–3] electrical conductivity anisotropy and intrinsic polarized photoresponse,[3–5] tunable Rashba spin-orbit coupling,[6] optical activity[7,8] and bulk photovoltaic effect (BPVE)[9]. However, since its properties depend on its crystal structure, for its successful integration into devices and the development of new applications, it is key to determine its crystallographic orientation and handedness and its interaction with light. In this work, using bulk single crystals, we show how the response of Te to polarized light depends on the crystal orientation which has implications for optical and electrical transport studies. By linearly polarized Raman spectroscopy we identify different crystal faces (1 0 0), (1 1 0) and (0 0 1) and the orientation of the trigonal axis corresponding to the helical Te chains. Moreover, we correlate the angle-resolved experimental patterns derived from the data analysis with the symmetry of the crystal. Furthermore, by circularly polarized measurements, we highlight that only for incidence parallel to the trigonal axis, i.e. in the (0 0 1) face, is possible to determine the handedness. In this case, we observe different peaks shift for left- and right-handed crystals in the corresponding cross-helicity Raman spectra. We support our findings with X-ray diffraction and chirality- and orientation-sensitive chemical etching, providing robust insights for the analysis of chiral and low-dimensional materials.[10]

References

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