



Transport Phenomena in Chiral Tellurium: Chirality-Induced Spin Selectivity and Nonlinear Hall Effect

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Thursday, February 26th @ 1:00 pm in BRK 1001

Abstract: The chirality-induced spin selectivity (CISS) effect, where chiral materials preferentially transmit electrons of a particular spin, has sparked intense interest through its scientific implications and spintronic applications such as giant magnetoresistance, anomalous Hall effect, selective enantiomer adsorption on a magnetic substrate, and enhanced electrocatalytic activity via spin polarization. Despite extensive research, its underlying mechanism is not clearly revealed yet. Even though the spatial distribution of spin polarization in chiral systems is one of the key clues to reveal the spin scattering mechanism in CISS, it has remained experimentally elusive. In this talk, CISS-based spin polarization induced by an electric current in nonmagnetic chiral tellurium nanowires will be demonstrated, which is probed by spatially resolved reflective magnetic circular dichroism measurements. The observed spin polarization scales linearly with current amplitude, aligns parallel to the current direction, reverses with chirality or current flow, indicative of CISS. Furthermore, the current-induced spin polarization exhibits identical signs in both the nanowire and electrodes, contrary to the presumed spin filter scenario so far. In addition, the spin relaxation lengths on graphene electrodes are measured to be several micrometers, in good agreement with previously reported values measured by electrical means such as spin valves. This work establishes a new paradigm for investigating spin-dependent phenomena in chiral materials and opens avenues for developing chirality-based spintronic and quantum devices. In addition, nonlinear Hall effect of Te will be presented, which is connected to the Berry curvature dipole of the inversion symmetry broken Te system.

Bio: Seon Namgung is an assistant professor in the Department of Physics at the Ulsan National Institute of Science and Technology (UNIST), Ulsan, South Korea. He received his Ph.D. in Physics from Seoul National University in 2011, following his B.S. in Physics from the same institution, under the supervision of Prof. Seunghun Hong. From 2012 to 2019, he conducted postdoctoral research in the Department of Electrical and Computer Engineering at the University of Minnesota, where his work bridged physics, materials science, and device engineering. He subsequently held a postdoctoral position in the Department of Physics at Seoul National University from 2011 to 2012. Since joining UNIST in 2019, Prof. Namgung has led research on optoelectronic devices based on low-dimensional materials and the development of quantum sensors. In 2024, he was appointed Director of the Quantum Sensing Application Center at UNIST, where he focuses on advancing quantum-enabled sensing technologies and their real-world applications.