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Fast Topological Switch Using Strained Weyl Semimetals

Stanford researchers have developed a topological switch using strained Weyl semimetals. Due to their robust electronic characteristics, high charge mobility, and nonlinear optical properties, Weyl semimetals have important applications in dissipationless electronics and fault-tolerant quantum computers. Their topological properties can be switched rapidly and energy efficiently by shear-tuning their crystal structures. Conventional means of shear tuning are insufficient and uncontrollable over time. Researchers at Stanford use light pulses to induce shear in Weyl semimetals, which transitions the semimetal layer to a second topological phase - analogous to transistor switching. This method provides new possibilities for ultrafast manipulation of the topological properties in solids and for a topological switch operating at THz frequencies.

Applications

- Next generation computing and post-silicon electronics
    - Fault-tolerant quantum computing
    - Dissipationless electronics at room temperature
    - Terahertz electronics including THz antennas and THz spectrometers

Advantages

- Ultrafast (picosecond timescale), and energy efficient (10x less that conventional means)
- Controllable, robust, effective topological switch - larger strain (10x) with less lattice damage compared to conventional piezoelectric transducer

Publications

- Edbert J. Sie, Clara M. Nyby, C. D. Pemmaraju, Su Ji Park, Xiaozhe Shen, Jie Yang, Matthias C. Hoffmann, B. K. Ofori-Okai, Renkai Li, Alexander H. Reid, Stephen Weathersby, Ehren Mannebach, Nathan Finney, Daniel Rhodes, Daniel Chenet, Abhinandan Antony, Luis Balicas, James Hone, Thomas P. Devereaux, Tony F. Heinz, Xijie Wang & Aaron M. Lindenberg, "An ultrafast symmetry switch in a Weyl semimetal". *Nature*, January 2, 2019.
- News and Views: "Topological properties controlled by light". *Nature*, January 2, 2019.

Patents

- Published Application: -20200075790-

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