Novel Logic and Global Positioning Capabilities with Germanene-Based Topological Insulators Through the Quantum Spin Hall Effect

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Topological insulators (TIs) are a new class of materials with an insulating interior and conducting surface states. I discovered new two-dimensional TIs based on GeI, that can be applied to logic and global positioning mechanisms. GeI's TI properties include a large band gap of 0.54 meV and a band inversion in its band structure. First, TIs allow superconductivity to be achieved along the surface, which opens up applications in logic devices. The superconductivity of GeI's surface states allows electrons to flow through the material with minimal energy input, enabling energy-efficient CPUs with longer battery lives to be manufactured. Second, the high carrier mobility and low carrier density of GeI could revolutionize global positioning technology. Currently, about 30 satellites form the basis of the GPS we use today. TI-based magnetic sensors, however, do not depend on such a framework. They work by detecting minute changes in external magnetic fields, such as that of the Earth, through precise measurement of the induced current. The positioning accuracy through implementation of TIs could increase from the order of meters to centimeters or even millimeters. This important property could be applied to greatly improve technologies such as self-driving cars, automated drones, and tracking systems.

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