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Giant multiferroic effects in topological GeTe/ Sb_2Te_3 superlattices

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Abstract

Multiferroics is a keyword for future electronics. However, it is still difficult to induce large electrical and magnetic properties at room temperature. It relies on that electric dipole moments are usually related to p-electrons while the magnetic moments are to d-electrons. If a large magnetic moment is induced from p-electrons, giant multiferroics would be possible. A combination of a topological insulator and a ferroelectric insulator may open a new era to realize such the multifunctionality. Topological insulators, such as Bi2Te3 and Sb2Te3, usually satisfy both spatial inversion and time reversal symmetry. The topological surface bands are mainly made of the band inversion of 6p- or 5p-electrons of Te, Sb, and Bi. On the other hand, GeTe is known as a ferroelectric material, which has a large spin-orbit coupling (SOC) compared with other oxide ferroelectric materials. Due to the large SOC, it shows a large Rashba-like spin split band. It is noted here that the existence of an electric dipole moment breaks the spatial inversion symmetry. If thin films of Sb2Te3 and GeTe are piled up alternatively, what happens on the band structure as the bulk film? Actually, both layers can share a lattice plane using (0001) and (111) through a van der Waals force. As the bulk film, the spatial inversion symmetry is broken. Therefore, plural Dirac cones appear apart from the Γ-point in the k-space, resulting in a Weyl semimetal. Weyl semimetals are magnetic sensitive because spin bands are lifted from the band degeneration. In the presentation, we show several experimental results of the Weyl semimetal from superlattices consisted of GeTe and Sb2Te3 sublayers at room temperature.

Biography

Junji Tominaga is a Prime Senior researcher in the Nanoelectronics Research Institute at the National Institute of Advanced Industrial Science and Technology (AIST), Japan. He received his PhD degree from Cranfield University, UK, in 1991. After studying optical phase-change memory at TDK Corporation, he joined AIST in 1997. He was the director of the Center for Applied Near-Field Optics Research until 2009. His research focuses on phase-change materials and application. He is the inventor of the super-resolution near-field structure (super- RENS) and the interfacial phase-change memory (iPCM) device. He was awarded the S.R. Ovshinsky Lectureship Award in 2014. He is a Fellow of The Optical Society and a member of IOP.

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