Researchers forward quest for quantum computing

May 23 2013

Research teams from UW-Milwaukee and the University of York investigating the properties of ultra-thin films of new materials are helping bring quantum computing one step closer to reality.

An on-going collaboration between physicists from York and the University of Wisconsin, Milwaukee, USA, is focusing on understanding, tailoring and tuning the electronic properties of topological insulators (TI) - new materials with surfaces that host a quantum state of matter – at the nanoscale.

Understanding the properties of thin films of the new materials and integrating them with semiconductors is an important step in creating a materials platform for quantum computers.

Professor Lian Li, from UW-Milwaukee, said: "The electrons on the surface of this material have some intriguing properties. All electrons are spinning in a quantum mechanical way, and spins are constantly knocked by random collisions (scattering).

"But on the surface of a topological insulator spinning electrons are protected from disruption by quantum effects, called time-reversal symmetry protection. This makes the materials attractive for spin-related electronics, or 'spintronics', which would use the orientation of the electron spin to encode information.

"In this work, we wanted to investigate if these properties of surface electrons are indeed 'protected' from scattering off of imperfections such as grain boundaries, a type of native and commonly found defect in the thin films made by nano size films growth techniques. And we found that these properties, although slightly modified, are indeed robust against such scattering effects."

Results of the team's latest research, which shows that the unique properties of a TI can be modified by intrinsic defects present in Bi_2Se_3 films when grown on graphene/silicon carbide (SiC), were featured on the front cover of a recent issue of the journal *Physical Review Letters*.

Dr Vlado Lazarov, from York's Department of Physics, said: "Topological insulators are like no other material we have seen before and can host completely new physics. Their surfaces are unique charge and spin conductors, with no dissipation. The perfectly aligned spin currents make topological insulators a prime platform for spintronics, a research field that is already revolutionising magnetic data storage.

"The challenge is to keep these properties at the microscopic scale so that they can be applied to quantum computing. We are exploring the properties of thin films, and questions such as whether inherent defects enhance or modify the materials' properties. We need to understand how to engineer these defects so that we can control the electronic properties of topological insulators if the dream of quantum computing is to become a reality."

More information: Liu, Y. et al. Charging Dirac States at Antiphase Domain Boundaries in the Three-Dimensional Topological Insulator Bi2Se3, *Physical Review Letters*, (2013). prl.aps.org/ 110, 186804

Provided by University of York

Citation: Researchers forward quest for quantum computing (2013, May 23) retrieved 20 April 2024 from https://phys.org/news/2013-05-quest-quantum.html

This document is subject to copyright. Apart from any fair dealing for the purpose of private study or research, no part may be reproduced without the written permission. The content is provided for information purposes only.