Spin-based electronics: New material successfully tested

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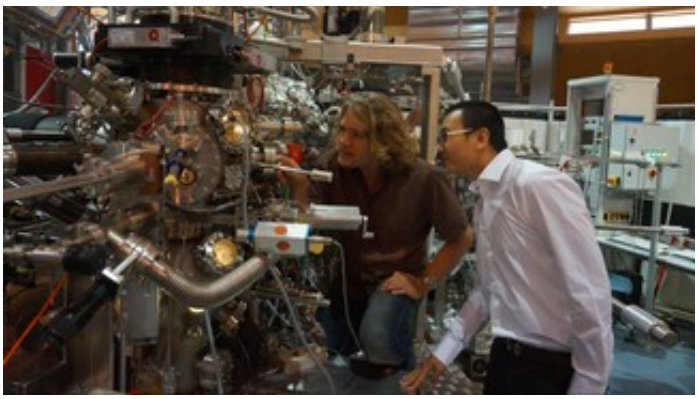

Hugo Dil and Nan Xu with their lab equipment at the Paul Scherrer Institute
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Spintronics is an emerging field of electronics, where devices work by manipulating the spin of electrons rather than the current generated by their motion. This field can offer significant advantages to computer technology. Controlling electron spin can be achieved with materials called 'topological insulators', which conduct electrons only across their surface but not through their interior. One such material, samarium hexaboride (SmB6), has long been theorized to be an ideal and robust topological insulator, but this has never been shown practically. Publishing in *Nature Communications*, scientists from the Paul Scherrer Institute, the IOP (Chinese Academy of Science) and Hugo Dil's team at EPFL, have demonstrated experimentally, for the first time, that SmB6

is indeed a topological insulator.

Electronic technologies in the future could utilize an intrinsic property of electrons called spin, which is what gives them their magnetic properties. Spin can take either of two possible states: "up" or "down", which can be pictured respectively as clockwise or counter-clockwise rotation of the electron around its axis.

Spin control can be achieved with materials called topological insulators, which can conduct spin-polarized electrons across their surface with 100% efficiency while the interior acts as an insulator.

However, topological insulators are still in the experimental phase. One particular insulator, samarium hexaboride (SmB6), has been of great interest. Unlike other topological insulators, SmB6's insulating properties are based on a special phenomenon called the 'Kondo effect'. The Kondo effect prevents the flow of electrons from being destroyed by irregularities in the material's structure, making SmB6 a very robust and efficient topological 'Kondo' insulator.

Scientists from the Paul Scherrer Institute (PSI), the Institute of Physics (Chinese Academy of Science) and Hugo Dil's team at EPFL have now shown experimentally that samarium hexaboride (SmB6) is the first topological Kondo insulator. In experiments carried out at the PSI, the researchers illuminated samples of SmB6 with a special type of light called 'synchroton radiation'. The energy of this light was transferred to electrons in SmB6, causing them to be ejected from it. The properties of ejected electrons (including spin) were measured with a detector, which gave clues about how the electrons behaved while they were still on the surface of SmB6. The data showed consistent agreement with the predictions for a topological insulator.

"The only real verification that SmB6 is a topological Kondo insulator

comes from directly measuring the electron spin and how it's affected in a Kondo insulator", says Hugo Dil. Although SmB6 shows insulating behavior only at very low temperatures the experiments provide a proof of principle, and more importantly, that Kondo topological insulators actually exist, offering an exciting stepping-stone into a new era of technology.

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