Superconducting topological crystalline insulator nanostructures: Candidate materials suitable for topological quantum computation

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Inspired by the discovery of topological insulators, material science on topological quantum phase that has shed light on Berry phase physics of wavefunctions has been of great interest. Notably, various types of topological materials have been searched and studied to demonstrate novel phenomena that can be derived from exotic properties of elementary excitations such as Dirac, Wyle, or Majorana fermions (MFs). In particular, searching for MFs – particles that are their own antiparticles, and therefore uncharged – is challenging but important for developing future quantum technologies. Topological materials that can superconduct are candidates to host the MFs at their surfaces. Recently, by tailoring metal-impurity levels in topological crystalline insulator tin telluride (SnTe) samples, we have observed surprisingly robust superconducting behaviour. In my talk, we will report the first successful growth of superconducting indium-doped SnTe (Sn1-xInxTe) nanoplates on Si substrates by a simple vapour transport method without employing any catalyst. The relation between the critical temperature and the carrier density was found to be consistent with that of bulk single crystals, suggesting that the superconducting properties of the nanoplate devices are essentially the same as those of bulk crystals. With the help of nanofabrication, growing the superconducting nanostructure crystals has opened exciting perspectives to fabricate devices for Majorana-based topological quantum computations.

Biography
Satoshi Sasaki has completed his PhD in 2006 from Kyoto University and worked as a Post-doctoral fellow at Laboratoire de Physique Statistique de l'Ecole Normale Superieure (France) and Northwestern University (USA) from 2006-2008. He has been an Assistant Professor of the ISIR, Osaka University (Japan) between 2008 and 2015 and joined the University of Leeds in 2015 as a Lecturer in the School of Physics and Astronomy. He has published more than 40 papers in reputed journals and has been serving as guest editor of a special issue of Crystals focused on “Topological Crystalline Insulators: Current Progress and Prospects”.

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