

Tokumoto LAB.

[Structure and Properties of Lattice Defects]



Department of Materials and Environmental Science

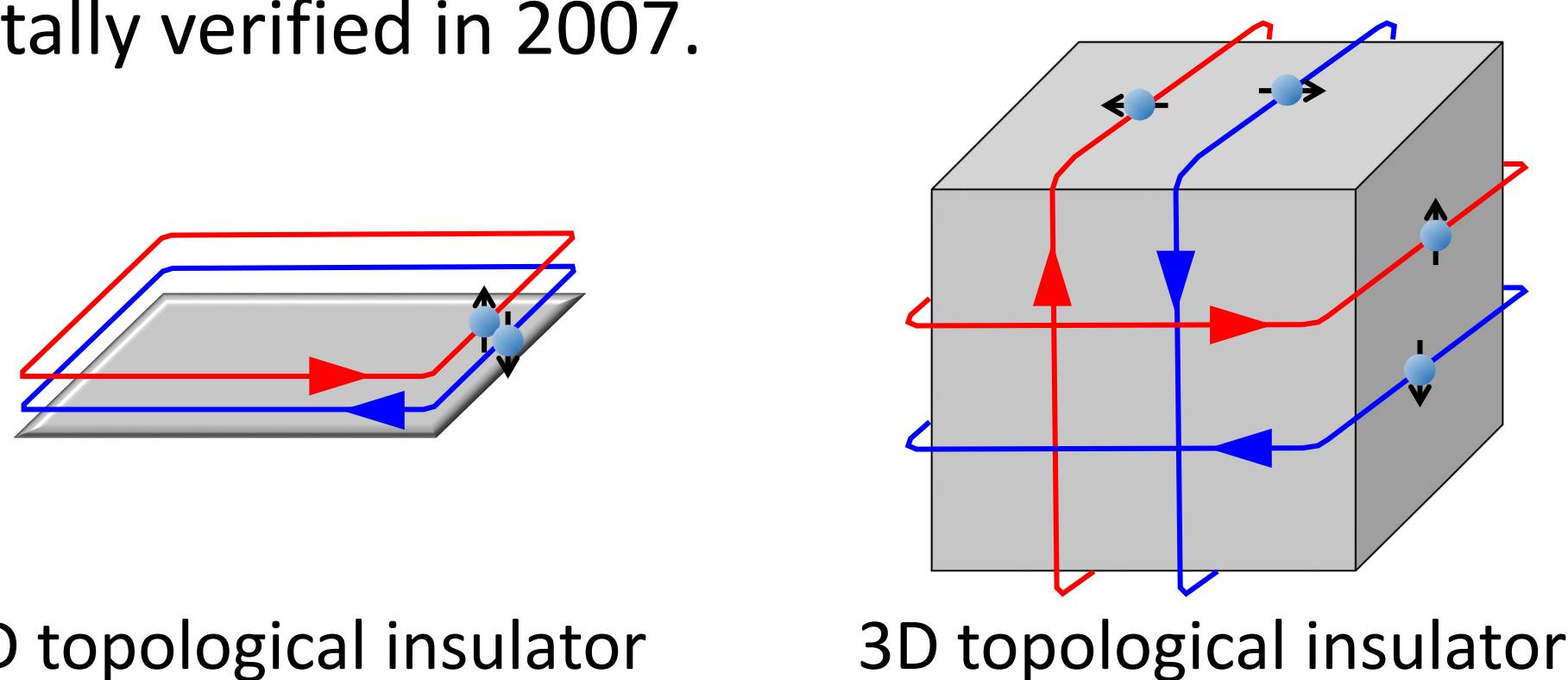
Nanostructure Materials Science

Department of Materials Engineering

<http://www.tokumoto.iis-u-tokyo.ac.jp>

◆ Topological insulator

Topological insulators are quantum materials that have a bulk band gap as an ordinary insulator but have protected metallic conducting states on their edge/surface. Topological insulators were first predicted in 2005, and have been experimentally verified in 2007.

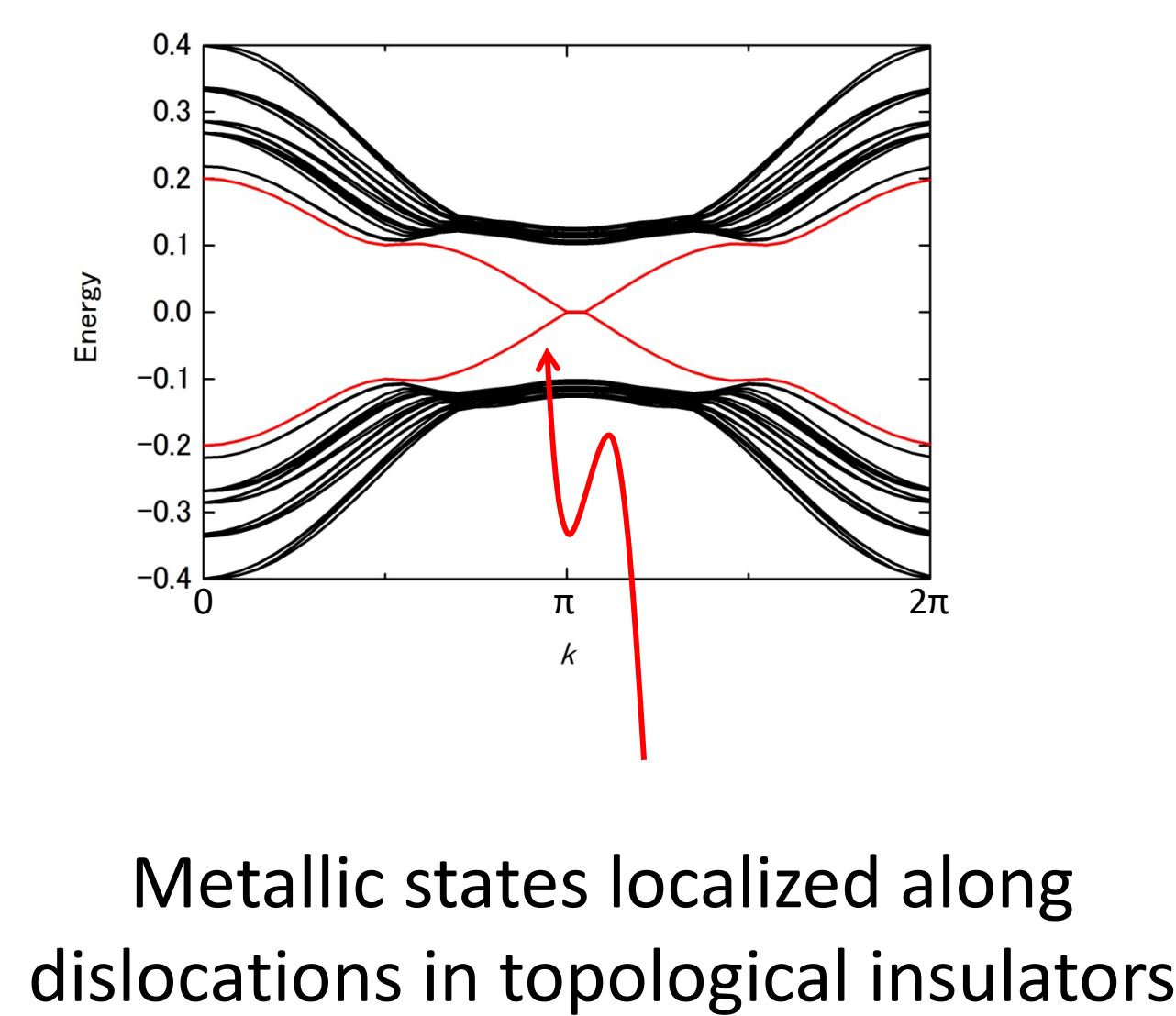
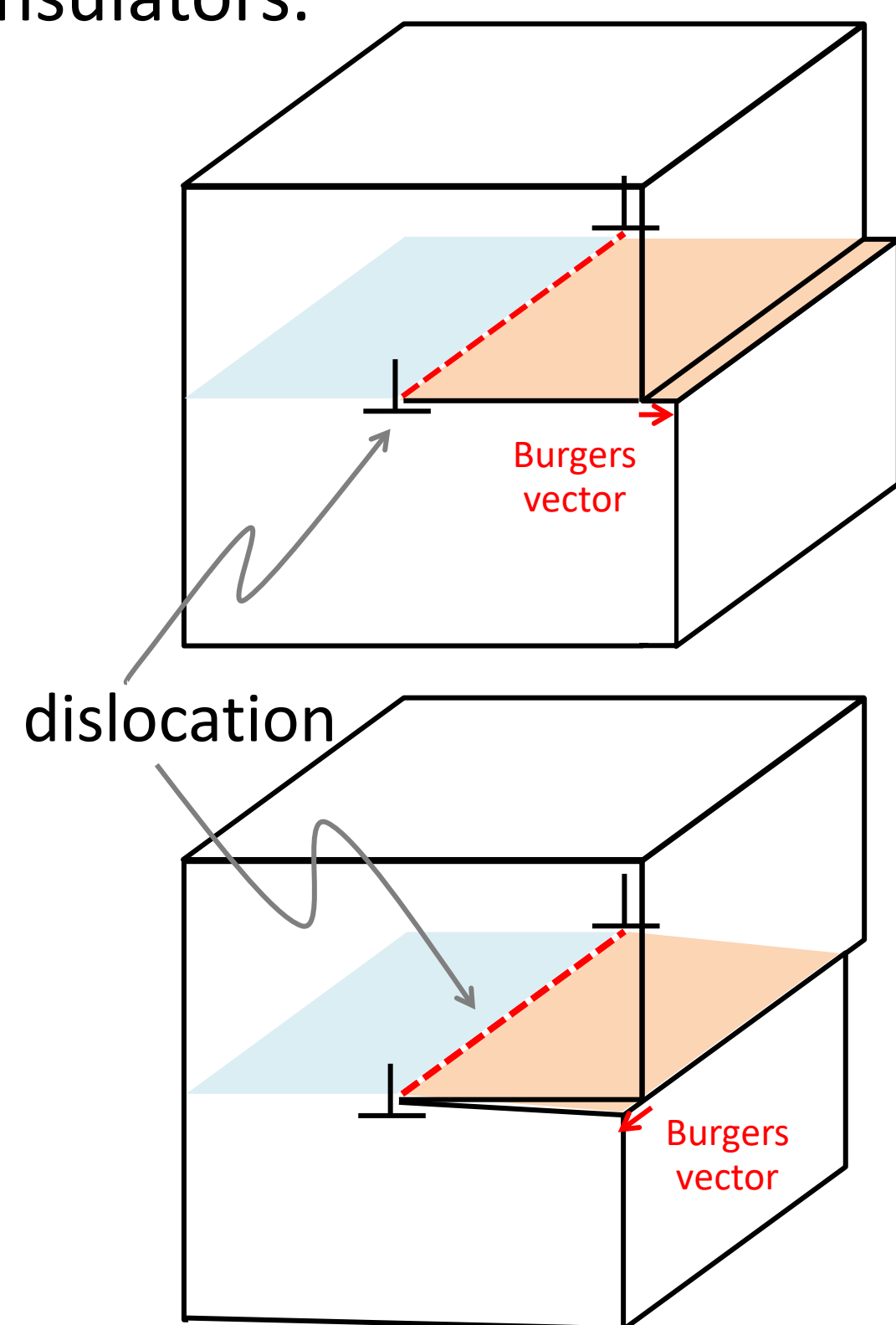


Metallic edge/surface states

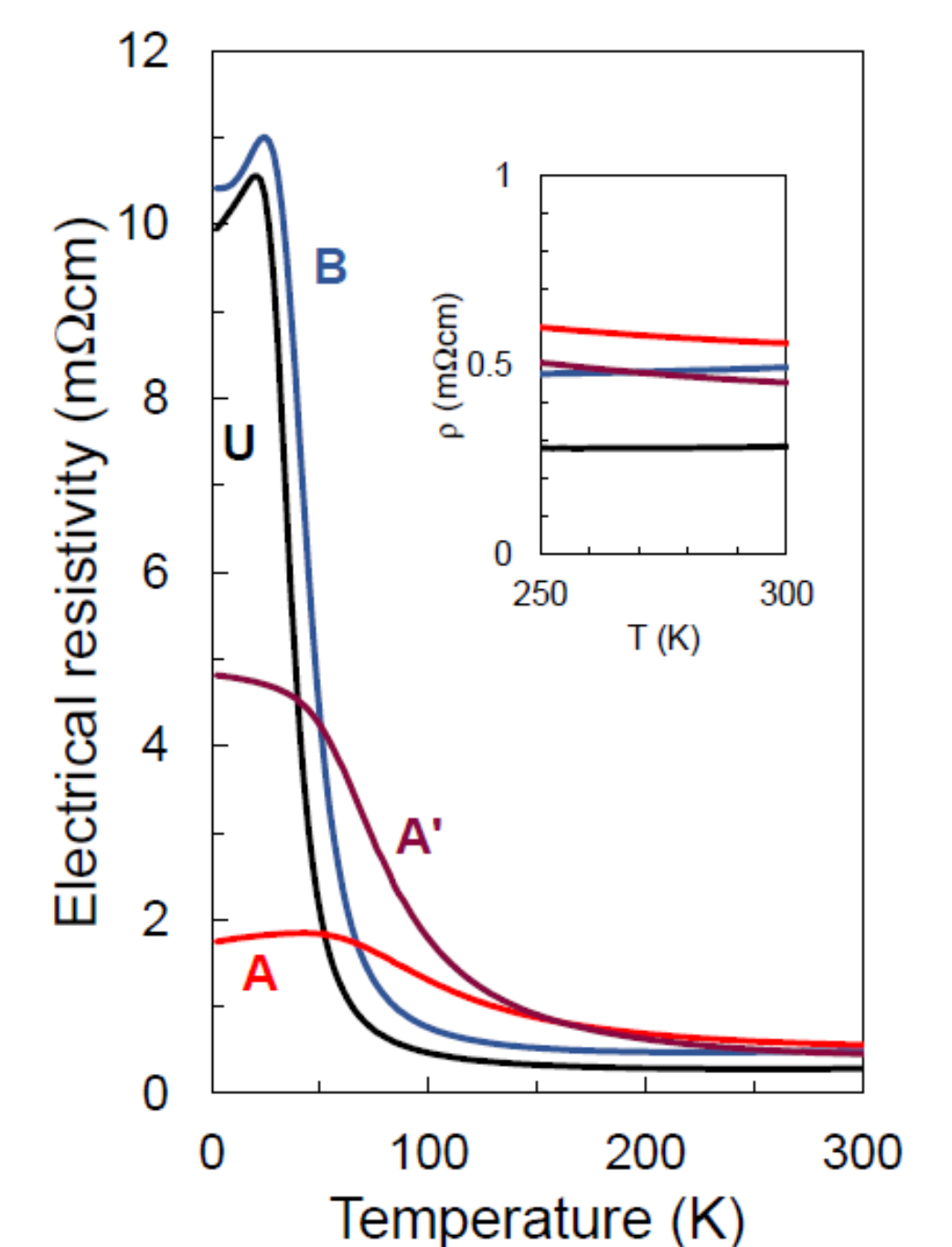
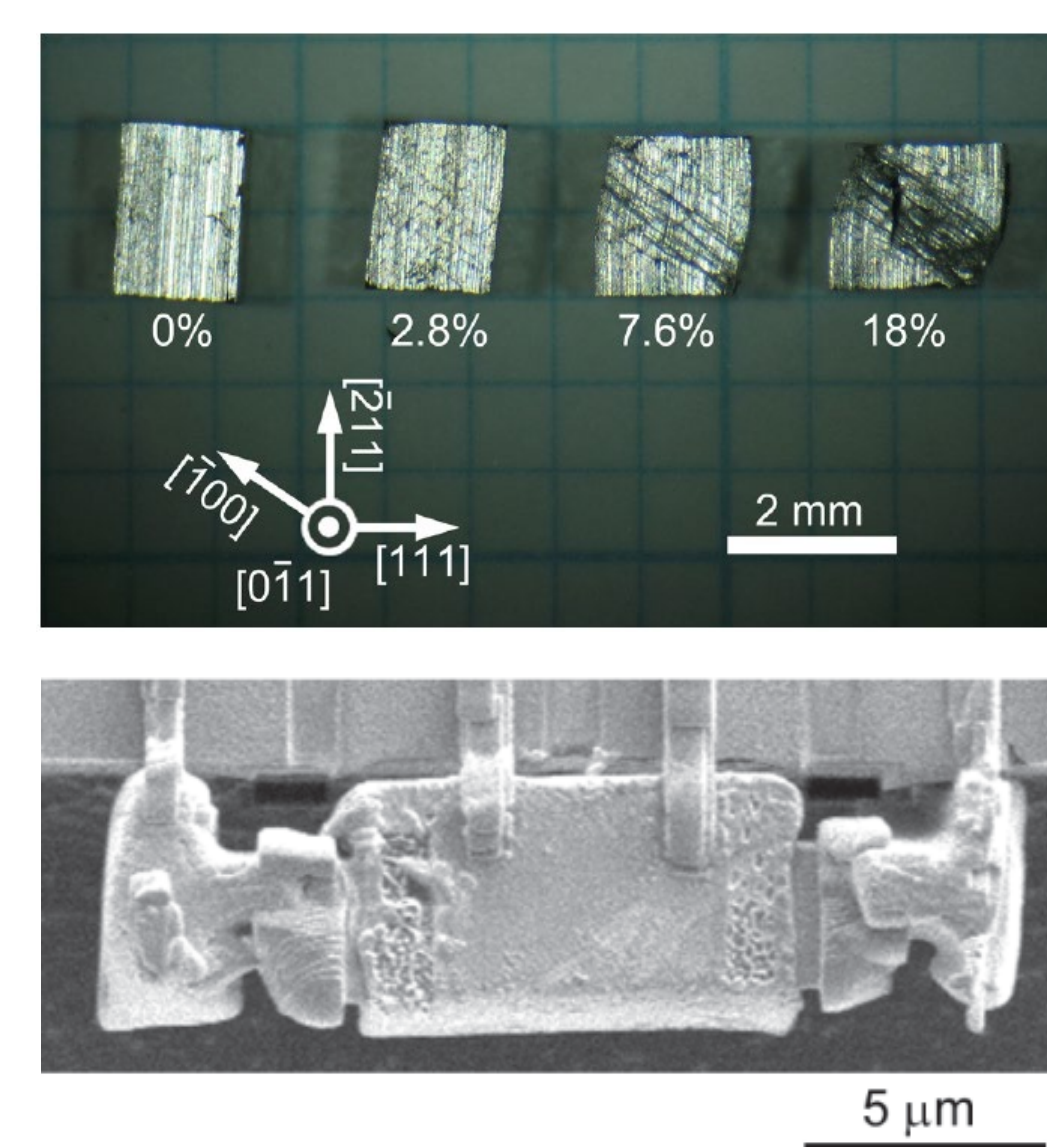
- helically spin-polarized
- massless Dirac fermions
- robust against nonmagnetic disorder

◆ Dislocations in topological insulators

In 2009, it has been theoretically predicted that the metallic states also occur along dislocations in 3D topological insulators.



Experimental verification of dislocation conduction in Bi-Sb topological insulator

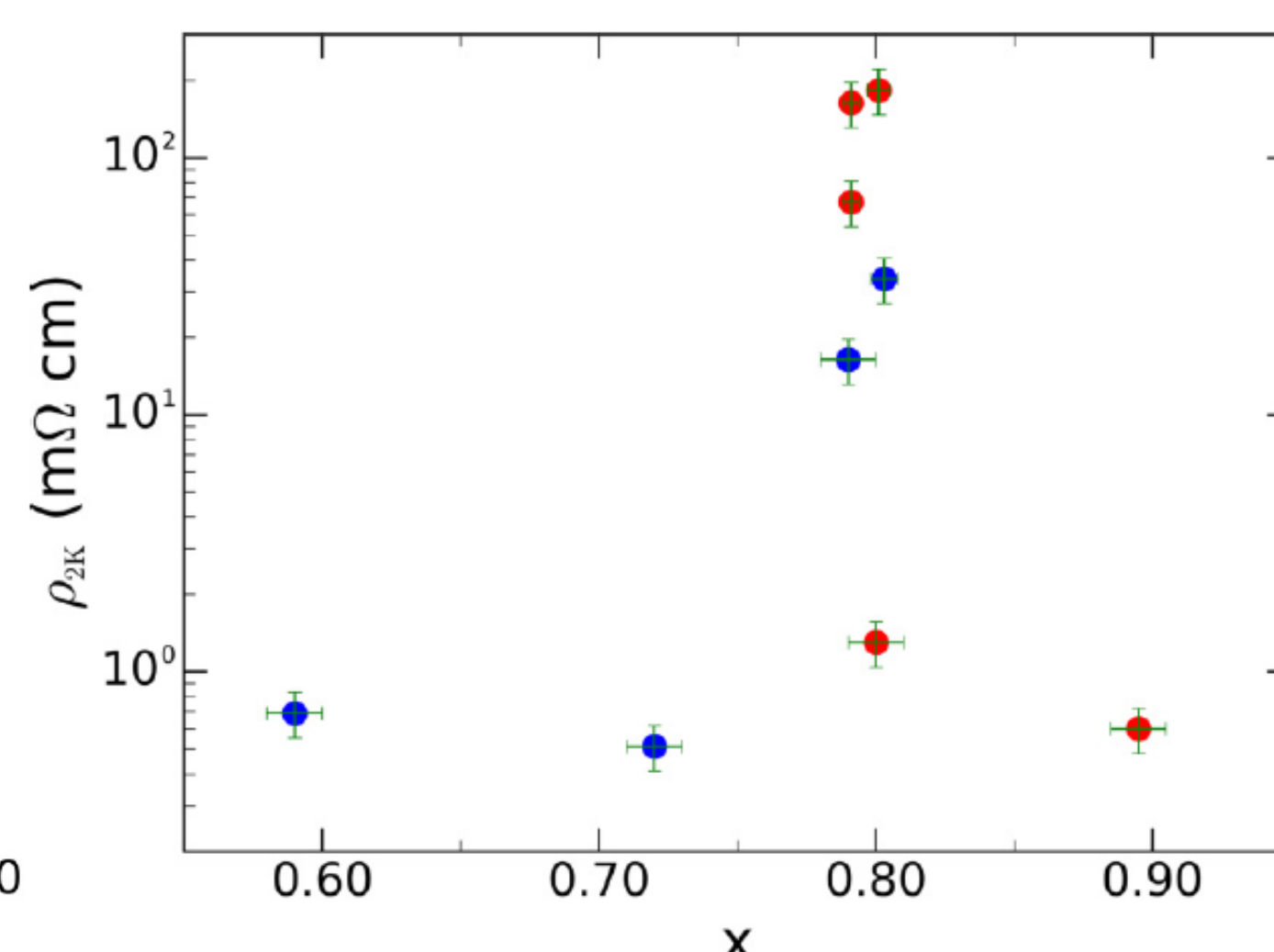
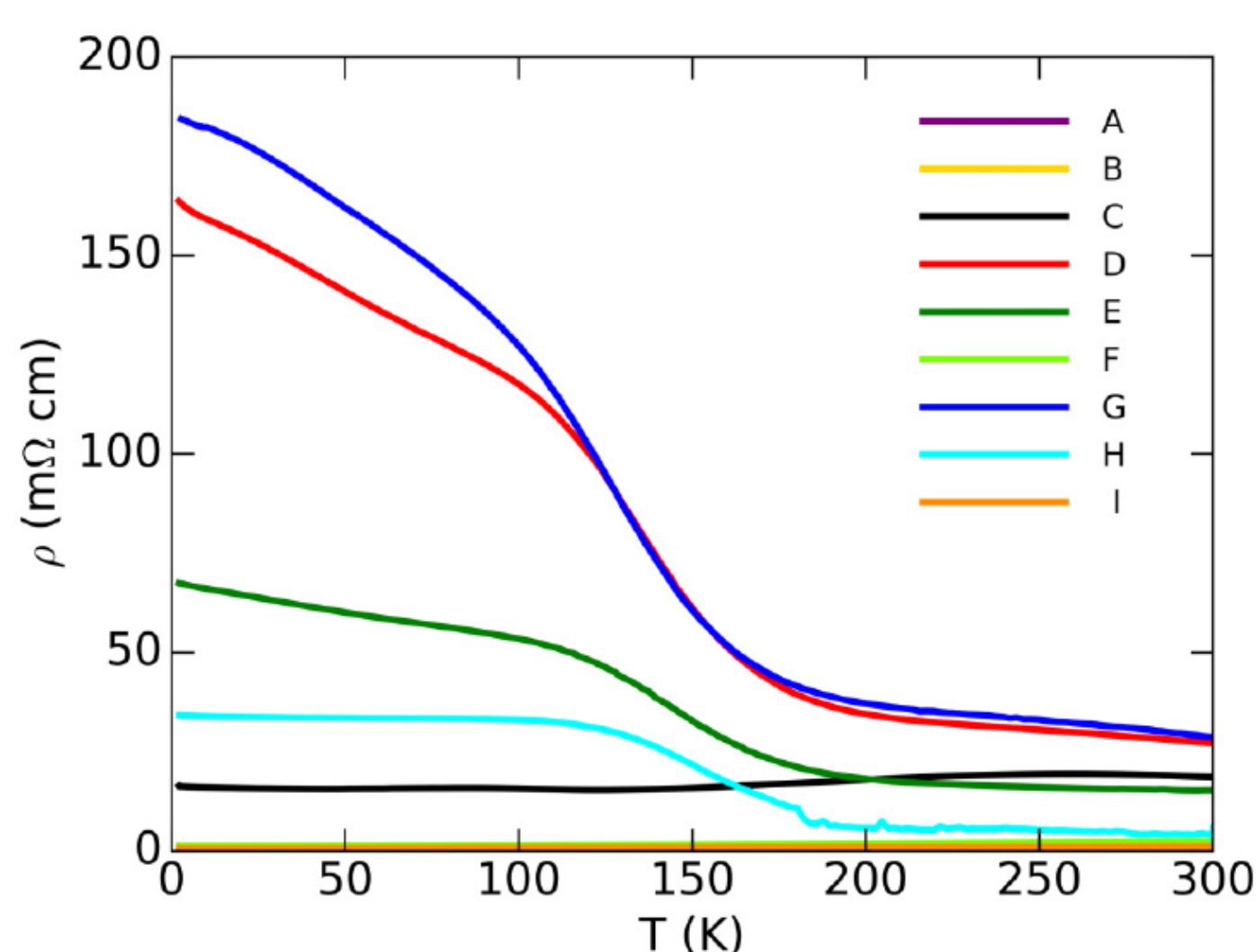


H. Hamasaki et al., *J. Phys. Soc. Jpn.*, **89** (2020) 023703.

◆ Enhancing bulk insulation of topological insulators

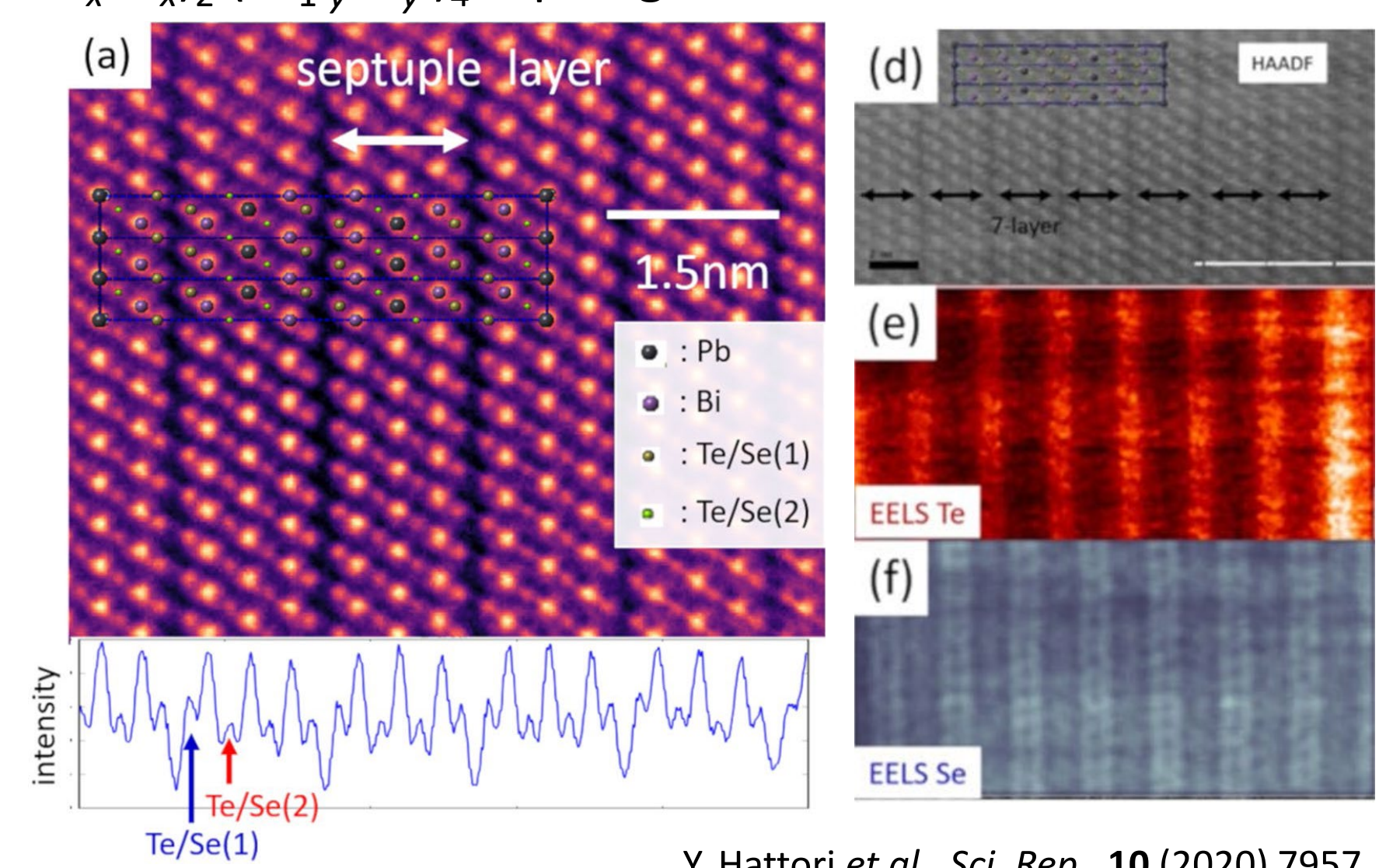
One of the most urgent tasks in the field of topological insulators is to achieve a bulk-insulating state, which is a prerequisite for the study of characteristic surface or dislocation transport phenomena.

Optimizing composition of $\text{Pb}(\text{Bi}_{1-x}\text{Sb}_x)_2\text{Te}_4$ topological insulator to achieve a bulk-insulating state



Y. Hattori et al., *Phys. Rev. Mater.*, **1** (2017) 074201.

Direct observation of Te/Se ordering, which is a key structure to achieve lower bulk conduction, in $\text{Pb}(\text{Bi}_{1-x}\text{Sb}_x)_2(\text{Te}_{1-y}\text{Se}_y)_4$ topological insulator.



Y. Hattori et al., *Sci. Rep.*, **10** (2020) 7957.

