Daisuke Yabe
K. Yarimizu[1], H. Sonoda[1], H. Tomori[1,2], K. Watanabe[3], T. Taniguchi[3], A. Kanda[1]
[1] Division of Physics and TIMS, University of Tsukuba, Tsukuba, Japan
[2] PRESTO, Japan Science and Technology Agency, Kawaguchi, Japan
[3] National Institute for Materials Science (NIMS), Tsukuba, Japan

s1620258@u.tsukuba.ac.jp

Superconducting Transition of Thin Layered Superconductor $NbSe_2$: Influence of Device Structures

Recently, by using the exfoliation technique developed for graphene, one can investigate the superconductivity of layered superconductors with atomic thicknesses. For layered superconductor $NbSe_2$, two groups have reported decrease of the superconducting transition temperature Tc with decreasing thickness, [1,2] but the reported Tc values differ in these reports. Here, to investigate the origin of the Tc difference, we studied the influence of device structures on the superconducting transition of $NbSe_2$ thin layers.

In the experiment, we fabricated two types of devices with $NbSe_2$ thickness of 10-20 nm (Fig. 1). In the air-exposure type, a cleaved $NbSe_2$ was placed on a SiO_2/Si substrate, followed by e-beam lithography and metal deposition to form Cr/Au electrodes. In the encapsulation type, thin films of $NbSe_2$ and multilayer graphene were transferred on top of an hBN flake in a glove box, and then electrodes were attached. After investigating the superconducting transition of these samples, we plasma-etched them and measured the transition again.

We observed that the exposure to the air slightly degrades the superconducting transition. Figure 2 shows superconducting transition of air-exposed and encapsulated samples before the etching. Tc and the width of the transition were 6.80 K and 0.12 K for the air-exposure type and 7.00 K and 0.07 K for the encapsulation type. Also, we found that the reactive ion etching (RIE) significantly degrades the superconducting transition, presumably due to the formation of defects.

References

[1] Y. Cao et al., Nano Lett., 10 (2015) 4914
[2] X. Xi et al., Nat. Phys., 12, (2016) 139

Figures

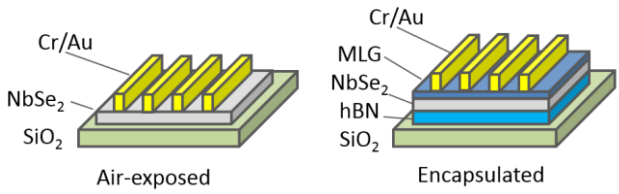

Figure 1: Schematics of the sample structures.

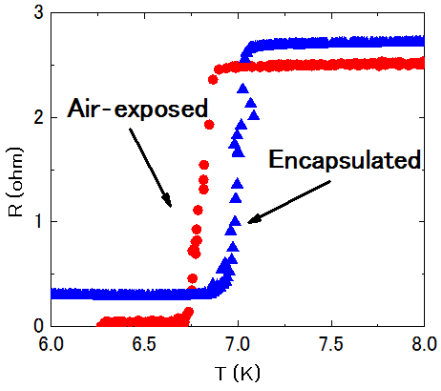

Figure 2: Temperature dependence of resistances of air-exposed and encapsulated samples before RIE.