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High-Tc superconductivity at 40 K emerged in ultrathin FeSe electric-double-layer transistors SHIOGAI JUNICHI, YUKIHIRO ITO, TOSHIKI MITSUHASHI, TSUTOMU NOJIMA, ATSUSHI TSUKAZAKI, Institute for Materials Research, Tohoku University — A few unit-cell (UC) FeSe films on SrTiO3 substrates have recently attracted much attentions owing to emergence of high temperature superconductivity (high-Tc) about 65 K compared to the bulk value of 8 K. Modulation of electronic structure, charge transfer from SrTiO3, and electron-phonon coupling between the film and substrate are proposed as possible origins for high-Tc. Although the in-situ scanning tunneling and photoemission spectroscopies have been intensively studied [1], systematic thickness, carrier density and substrate material dependences of electrical measurements have been limited so far. Here we report on high-Tc in FeSe films on SrTiO3 and MgO in electric-double-layer transistor (EDLT) [2]. Both the film thickness and electric field can be tuned by electrochemical etching and electrostatic doping in EDLT. The systematic thickness dependences reveal that the onset Tc of 40 K appears from around 10 nm to 1 UC under the electric field while the initial 18-nm-thick FeSe shows no high-Tc. Our results point out the importance of electron accumulation or electronic band modulation for high-Tc in FeSe rather than electron-phonon coupling. [1] Q. Y. Wang et al., Chin. Phys. Lett. 29, 037402 (2012). [2] J. Shiogai et al., Nature Physics (2015).

Shiogai Junichi
Institute for Materials Research, Tohoku University

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