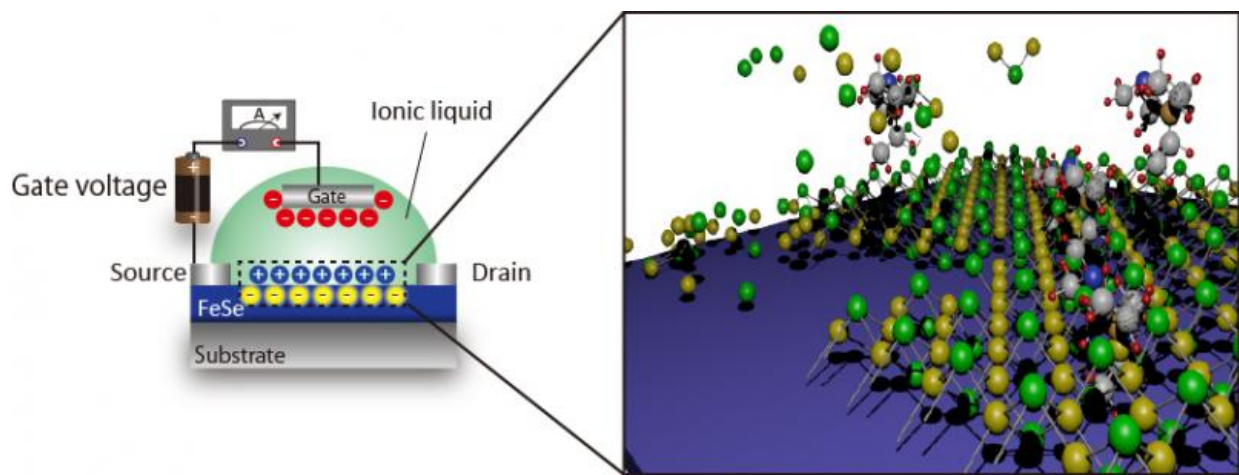


# Electrochemical etching down to one-monolayer towards high- $T_c$ superconductivity

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(Left) Device structure of electric-double-layer transistor with FeSe channel deposited on oxide substrate. (Right) One-monolayer FeSe is realized by electrochemical etching where Fe and Se ions are dissolved into ionic liquid. Credit: Junichi Shiogai

Iron selenide (FeSe) is an attracting superconducting material since the superconducting transition temperature ( $T_c$ ) is enhanced from 8 K in bulk form toward 65 K in one-monolayer form.

However, systematic thickness dependence of electrical measurement has been difficult to address.

A team of researchers at Tohoku University's Institute for Materials Research (IMR), has realized layer-by-layer etching in superconducting FeSe films down to approximately one-monolayer about 0.6 nm using classical electrochemical reaction in electric-double-layer transistor configuration.

As the thickness of the films becomes thin, the superconducting [transition temperature](#) ( $T_c$ ) is increased from bulk value (8 K) to about 40 K. In addition, the research group unveils that by combining with an electrostatic charging effect, the high- $T_c$  transition can be induced in 10-nm thick condition (20 monolayers), which had been limited in one/two-monolayers so far.

The development of this etching technique will pave the way for the exploration of nontrivial physical phenomena in atomically thin two-dimensional [films](#). This had previously been difficult to address by conventional methods.

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**More information:** J. Shiogai et al. Electric-field-induced superconductivity in electrochemically etched ultrathin FeSe films on SrTiO<sub>3</sub> and MgO, *Nature Physics* (2015). [DOI: 10.1038/nphys3530](https://doi.org/10.1038/nphys3530)

Provided by Tohoku University

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