Superconductivity in 2D Materials

Yoshi Iwasa
Department of Applied Physics and QPEC, University of Tokyo
RIKEN Center for Emergent Matter Science (CEMS)

2D materials are a rich platform of designing novel properties and functions.Recent technological advances of materials fabrication have led to discoveries of a variety of 2D superconductors [1]; such asmechanically exfoliated mono or a few layers, heterointerfaces, electric-double-layer transistors, and molecular-beam-epitaxy grown or chemical vapor deposited atomically thin layers. All these 2D superconductorshave very high crystallinity in marked contrast with the conventional 2D superconductors with amorphous or granular structures, and thus provide opportunities for investigating the intrinsic nature of 2D superconductors, reflecting the high crystallinity of 2D materials.

Here we discuss gate-induced 2D superconductivity using electric double layer transistor (EDLT) devices. Electrostatic charge accumulations induces superconductivity with truly 2D nature, exhibiting rich novel properties that includequantum metallic states (Bose metal), quantum Griffiths phases, dramatically enhanced Pauli-limit due to the spin-orbit interactions, and nonreciprocal superconducting transport. Also, EDLTs was found to offer a new opportunity to control electrochemical reactions, which allows us to access superconductivity in monolayer FeSe and very lightly doped superconductor toward BCS-BEC crossover.

References

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