MAR16-2015-005914

Abstract for an Invited Paper
for the MAR16 Meeting of
the American Physical Society

2D superconductivity by ionic gating[1]

YOSHI IWASA, The University of Tokyo AND RIKEN CEMS

2D superconductivity is attracting a renewed interest due to the discoveries of new highly crystalline 2D superconductors in the past decade. Superconductivity at the oxide interfaces triggered by $LaAlO_3/SrTiO_3$ has become one of the promising routes for creation of new 2D superconductors. Also, the MBE grown metallic monolayers including FeSe are also offering a new platform of 2D superconductors. In the last two years, there appear a variety of monolayer/bilayer superconductors fabricated by CVD or mechanical exfoliation. Among these, electric field induced superconductivity by electric double layer transistor (EDLT) is a unique platform of 2D superconductivity, because of its ability of high density charge accumulation, and also because of the versatility in terms of materials, stemming from oxides to organics and layered chalcogenides. In this presentation, the following issues of electric filed induced superconductivity will be addressed; (1) Tunable carrier density, (2) Weak pinning, (3) Absence of inversion symmetry. (1) Since the sheet carrier density is quasi-continuously tunable from 0 to the order of 10^{14} cm^{-2}, one is able to establish an electronic phase diagram of superconductivity, which will be compared with that of bulk superconductors. (2) The thickness of superconductivity can be estimated as 2 – 10 nm, dependent on materials, and is much smaller than the in-plane coherence length. Such a thin but low resistance at normal state results in extremely weak pinning beyond the dirty Boson model in the amorphous metallic films. (3) Due to the electric filed, the inversion symmetry is inherently broken in EDLT. This feature appears in the enhancement of Pauli limit of the upper critical field for the in-plane magnetic fields. In transition metal dichalcogenide with a substantial spin-orbit interactions, we were able to confirm the stabilization of Cooper pair due to its spin-valley locking.

[1]This work has been supported by Grant-in-Aid for Specially Promoted Research (No. 25000003) from JSPS.