Expanding Possibilities of π electrons in Molecular Conductors

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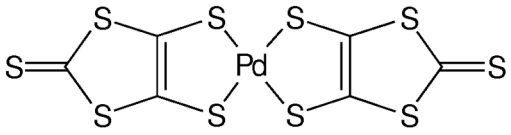
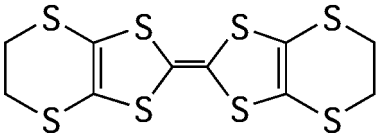
Molecular conductors provide stages where π electrons play various roles. Our grand challenge is to expand possibilities of π electrons in molecular conductors and enhance their performance up to limit. Our recent research topics concerning this issue are
• π electrons in two-dimensional Mott system with a quasi-triangular lattice [1]
• Dual-faced π electron (itinerant electron and localized spin) [2]
• π electrons in Massless Dirac fermion state [3]
• Photo-induced transition in charge ordered π electron systems [4]
• Field effect transistor (FET) behavior of π electrons in organic Mott insulators [5].
The above phenomena are associated with various degrees of freedom, including charge, spin, lattice, and orbital.

Among them, we found that anion radical salts of $Pd(dmit)_2$ belong to an excellent two-dimensional Mott system with a quasi-triangular lattice formed by $[Pd(dmit)_2]_2^-$ dimers. The spin frustration in the Mott insulating state at ambient pressure is removed by various transitions, including antiferromagnetic ordering, (intra- and inter-dimer) charge ordering, and valence bond ordering (spin gap formation) at low temperatures. We demonstrated that the Mott insulating state can be suppressed by the application of hydrostatic or uni-axial pressure, which leads to metallic behavior accompanied by superconductivity. Especially, the discovery of the superconductivity adjacent to the valence bond ordering was of special interest from the viewpoint of the superconductivity mechanism [6,7].



$Pd(dmit)_2$



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