Molecular Design of Organic (Super)conductors

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We introduce the development of conductive organic molecular assemblies including organic metals, superconductors, single component conductors, conductive films, and conductive liquids, particularly focusing on our own research achievements of molecular design within the framework of both real and energy spaces. The figure represents the strategy for chemical modification of the TTF molecule to increase or decrease the electronic dimensionality by the aid of an increase or suppress the self-assembling ability of the molecules, respectively. Strong two-dimensionality (2D) of BEDO-TTF compounds gave stable metals toward disorder, while moderate to weak 2D of BEDT-TTF gave unstable metals, superconductors, & Mott insulators (AF & spin-liquid). The 1D EDO-TTF gave a PIPT system arising from multi-instability of Peierls instability, charge ordering, and order-disorder transition. Depending on the length of alkyl chains and the kinds of hetero atoms in the π-segment in TYC_n-TXF, they afforded single-component conductors having robust 1-3D conduction paths by the aid of Fastening Effect or Hetero-Atomic Contacts.