TOPICAL REVIEW

Tetrathiapentalene-based organic conductors

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Yohji Misaki
Department of Applied Chemistry, Graduate School of Engineering, Ehime University, 3 Bunkyo-cho, Matsuyama 790-8577, Japan
E-mail: misaki@eng.ehime-u.ac.jp

Abstract. The synthesis, structure and properties of tetrathiapentalene-based (TTP) organic conductors are reviewed. Among various TTP-type donors, bis-fused tetrathiafulvalene, 2,5-bis(1,3-dithiol-2-ylidene)-1,3,4,6-tetrathiapentalene (BDT-TTP) and its derivatives afford many metallic radical cation salts stable down to low temperatures, regardless of the size and shape of the counter anions. Most BDT-TTP conductors have a β-type donor arrangement with almost uniform stacks. Introduction of appropriate substituents results in molecular packing that differs from the β-type. A vinylogous TTP, 2-(1,3-dithiol-2-ylidene)-5-(2-ethanediylidene-1,3-dithiole)-1,3,4,6-tetrathiapentalene (DTEDT) has yielded an organic superconductor $(DTEDT)_3Au(CN)_2$ as well as metallic radical cation salts, regardless of the counter anions. (Thio)pyran analogs of TTP, namely (T)PDT-TTP and its derivatives produce molecular conductors with novel molecular arrangements. A TTP analog with reduced π-electron system 2,5-bis(1,3-dithian-2-ylidene)-1,3,4,6-tetrathiapentalene (BDA-TTP) has afforded several organic superconductors. Highly conducting molecular metals with unusual oxidation states (+1, +5/3 and neutral) have been developed on the basis of 2,5-bis(1,3-dithiol-2-ylidene)-1,3,4,6-tetrathiapentalene (BDT-TTP) derivatives and analogous metal derivatives $M(dt)_2$ (M = Ni, Au).

Keywords: molecular conductor, tetrathiapentalene, cyclic voltammetry, x-ray structure analysis, band calculation

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