Crystalline Supramolecular Nano-wires Based on TTF Derivatives (TTF = tetrathiafulvalene)

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Crystalline nano-wires have been prepared from various TTF derivatives coupled with insulating supramolecular assemblies. The supramolecular assemblies comprise halide anions and iodine-containing neutral molecules connected to each other by halogen bonds.

(EDT-TTF)4BrI2(TIE)5, the first example of such crystalline nano-wire, exhibits conductivity anisotropy of 2000. (EDT-TTF = ethylenedithiotetrathiafulvalene, TIE = tetraiodoethylene) The semiconductive temperature dependence of the electrical resisitivity can be interpreted in terms of a defect-containing resists array model. (EDT-STF)I3(TIE)5 also shows very similar conduction properties. (EDT-STF = ethylenedithiodiselenadithiafulvalene)

In the crystal of (BPDT-TTF)2Cl2(DFBIB), we have found double donor column structure in one wire, which will enable defect-tolerant nano-wire system. (BPDT-TTF = bispropylenedithiotetrathiafulvalene, DFBIB = difluoro-bis(iodoethynyl)benzene)

The thickness of the supramolecular insulating cover has, on the other hand, been successfully increased to 1 nm in the salt (TSeF)Cl(HFTIEB). (TSeF = tetraselenafulvalene, HFTIEB = hexafluoro-tetrakis(iodoethynyl)-biphenyl) The resisitivity of the crystal in the perpendicular direction to the wire axis was very high, so that the resisitivity anisotropy has rose above 10^8. This is the highest anisotropy as a single chemical substance as far as we know. Such excellent insulation between nano-wires is critical electric property in the practical use of nano-wires.