Wave-Particle Dual Nature and Phase Diagram of Organic Conductors

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Organic conductors are constructed by stacking molecules [1]. Many of them have low-dimensional electric conductivity. As dimensionality is lowered, a normal metallic state becomes unstable toward a formation of spin/charge/lattice order. At the same time, quantum fluctuations become large and can suppress any long-range order. Dimensionality is controlled by changing temperature or pressure, which can enhance either the "wave" character or the "particle" character. Photoexcitation of an organic salt is recently found to produce a transient state where high conductivity due to delocalized electrons (with "wave" character) coexists with charge order due to localized electrons (with "particle" character) [2].

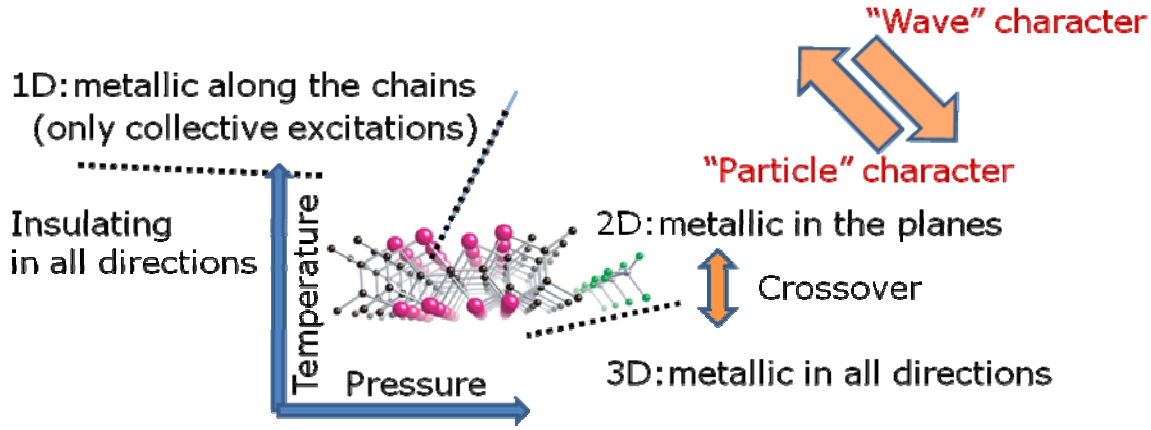

Fig. 1 Dimensionality of metallic conductivity can be controlled by temperature or pressure.

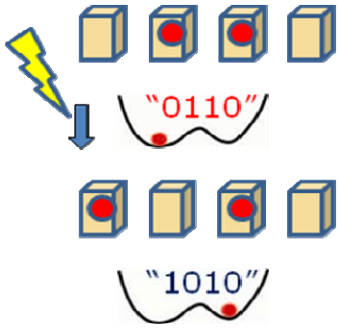

Fig. 2 Photoexcitation can change the charge order pattern.

Fig. 3 At high energies, local charge transfer is observed.

Fig. 4 At low energies, delocalized electron motion is observed.

[1]. Special Topics on "Organic Conductors," J. Phys. Soc. Jpn. **75**, 051001–051016 (2006).

[2]. K. Onda, S. Ogihara, K. Yonemitsu, *et al.*, Phys. Rev. Lett. **101**, 067403 (2008).