Control of the electronic state in a series of $Pd(dmit)_2$ salts, a strongly correlated electron system with a quasi-triangular lattice structure

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Anion radical salts of metal dithiolene complex $Pd(dmit)_2$ (dmit=1,3-dithiol-2-thione-4,5-dithiolate) with tetrahedral counter cations (Me_4Z^+ and $Et_2Me_2Z^+$; Z=N, P, As, Sb) belong to a strongly correlated two-dimensional system. At ambient pressure, they are Mott-insulators where spin-1/2 dimer ($[Pd(dmit)_2]_2^-$) units form a two-dimensional quasi-triangular lattice. The electronic state of this system is governed by various parameters including the effective on-site Coulomb energy on the dimer ($U_{eff.}$), the band width (W), and the degree of frustration, each of which is sensitive to the intra- and/or inter-dimer interactions. The application of hydrostatic or uni-axial pressure can control these parameters. These pressure effects strongly depend on the choice of the counter cation.

The application of hydrostatic pressure can reduce the electron correlation parameter ($U_{eff.}/W$) and lead the system to the metallic state accompanied by the superconductivity. In the Et_2Me_2P salt (space group *C2/c*), further application of hydrostatic pressure induces another non-metallic behavior. This is due to a partial nesting of the Fermi surface associated with a structural transition which removes the glide plane and the two-fold axis.

The uni-axial strain provides two different routes toward the metallic state. The one is an enhancement of the band width and the other is that of the frustration. The uni-axial strain can also induce a kind of self-doping which makes the system metallic. On the other hand, the uni-axial strain perpendicular to the molecular plane enhances the insulating behavior in the low-pressure region, which is due to an enhancement of $U_{eff.}$.