Phase transition between charge density wave and Mott-Hubbard state in low dimensional organic conductor measured by low temperature STM

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Among a wide variety of low dimensional organic conductors, 1D halogen-bridged complexes have attracted much attention because they can be regarded as prototypical system of Peierls-Hubbard model, in which relative strength between electron-lattice interaction and electron-electron interaction compete with each other. Phase transition between charge density wave (CDW) and Mott-Hubbard phase has been studied by XRD, XPS and IR spectroscopy; however those methods only provide spatially averaged information. In this study, to investigate detailed dynamics of the phase transition, we performed variable temperature STM experiment using LT-STM.

Fig.1 shows crystal structure of $[Pd(chxn)_2Br]Br_2$ investigated in this study. A sequence of Pd - Br linear chain formed along *b* axis. Fig.2(a) shows the surface of *bc* - plane obtained at 113K. In empty state STM image, Pd atoms are located in the center of bright protrusions, whose height reflects valence number of each Pd atom. In right half of the image, height of Pd atom changed alternatively along *b* axis due to the formation of charge density wave (Pd^{4+}–Pd^{2+} 2x1 CDW phase), whereas Pd atoms in left half of the image had nearly equivalent height which is a signature of Mott-Hubbard state (Pd^{3+}–Pd^{3+} 1x1 phase). On the other hands, 1x1 Mott-Hubbard state was dominantly observed at 106K as shown in fig.2(b). Those results clearly demonstrate phase transition between CDW phase and Mott-Hubbard state around *T*c ~ 110K.

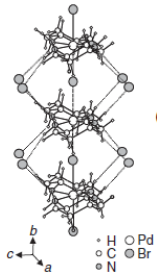

Fig.1 $[Pd(chxn)_2Br]Br_2$

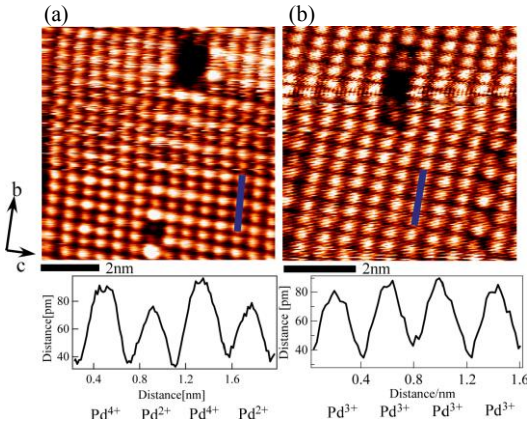

Fig.2 STM image at (a)113K and (b) 106K