Recently non-linear conductivity of charge-ordered molecular conductors has attracted much attention because of appearance of giant nonlinear conduction with low activation voltage, thyristor-like oscillation [1], and electric-field (EF)-induced metastable state [2]. In order to clarify the metastable state, the simulation of time resolved $V_{\text{sample}}$ under EF assumed for the self-heating and the observation of raman spectroscopy of checkerboard-type charge-ordered molecular conductor $\beta$-(meso-DMBEDT-TTF)$_2$PF$_6$ were carried out. The comparison between experimental and calculated results indicates that the EF responses under $V_{\text{circuit}} = 3$ V such as resistance drop and metastable state are a non-thermal but an intrinsic EF effect (Fig.1). Moreover, the metastable state observed by the synchronized raman spectra suggests non-coexistence of charge-ordered insulating and metallic states, but a homogeneous fluctuated charge-ordered state. In the electric-field-induced metastable state with $100 < R < 1000$ ohm, the confined charges by the Coulomb interaction are averaged and the melting of superlattice might be delayed.


Fig. 1 (a) Experimental and (b) calculated results of time-dependent $V_{\text{sample}}$ under $V_{\text{circuit}} (= 2 – 3$ V) at 60 K for $\beta$-(meso-DMBEDT-TTF)$_2$PF$_6$. (b) The arrows indicate the field-induced metastable states and (b) the self-heating simulation is carried out without (solid line) and with (dotted line) radiation through gold wire.