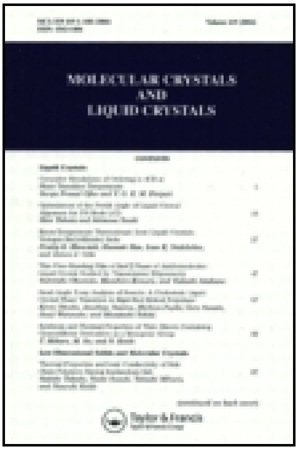

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Electrical Response Of $K_{0\,30}MoO_3$ Around Incommensurate-Nearly Commensurate Change At 100k

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ELECTRICAL RESPONSE OF $K_{0.30}MoO_3$ AROUND INCOMMENSURATE-NEARLY COMMENSURATE CHANGE AT 100K

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Abstract Electrical response and structural change were investigated in $K_{0.30}MoO_3$ in the charge-density wave state around 100K, where the wave vector of the charge-density wave stopps changing.

INTRODUCTION

Non-linear transport properties are the subjects of recent investigations of one-dimensional conductors. Non-linear conductivity[1], narrow band noise[2], and broad band noise are attributed to the depinning of the charge-density wave (CDW) by electric fields. Electrical hysteresis[3] and the transient response observed in the trichalcogenides[4] and blue bronzes[5] are considered to be related to the metastability of CDW. In this article, we report the electrical response and the structural change of $K_{0.30}MoO_3$.

EXPERIMENTAL RESULTS AND DISCUSSIONS

As far as the electrical response is concerned, we found two types of samples of $K_{0.30}MoO_3$. One is the "switching" sample which shows sudden onset of non-linear conduction with a resistance drop at the threshold field. The other is the "non-switching" sample which smoothly decreases the resistance above the threshold field as in $NbSe_3$. For bidirectional current pulses exceeding the threshold

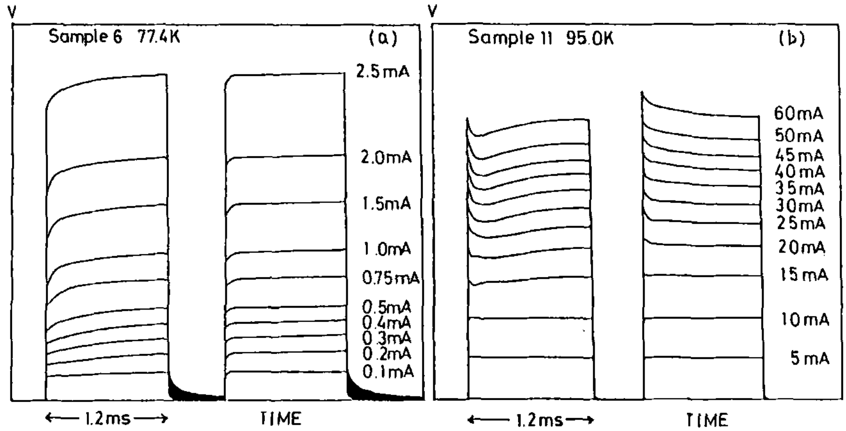

FIGURE 1 Responses to positive current double pulses after applying enough negative current pulse. (a) is "non-switching" sample (I_C=0.10mA). (b) is "switching" sample (I_C=16mA)

current, non-switching samples show one type of transient response as shown in Fig. 1(a). Just after the application of the current pulse, the sample is in more conductive state. Then it relaxes to the steady state. Switching sample show another kind of relaxation as shown in Fig. 1(b). The cusp is considered to be related with the pinning of CDW. Both kinds of relaxations decrease their magnitude above about 100K. For both kinds of samples threshold field increases with increasing temperature.

To study the structural change due to the field, time resolved x-ray diffraction experiments were made under electric fields using a synchrotron radiation facility (SOR) in KEK at Tsukuba. X-ray wave length of 1.198A was used. Diffraction intensity was measured by a solid-state detector. Practical resolution estimated from the widths of ordinary Bragg reflections are 0.009$\mathring{A}^{-1}$, 0.003$\mathring{A}^{-1}$, and 0.009$\mathring{A}^{-1}$ along the b^*-, $(2a^*-c^*)$-, and (a^*+2c^*)-directions, respectively. Bidirectional pulsed electric currents were applied. Detected x-ray signals were accumulated by a multichannel analyzer in the multichannel scaling (MCS) mode. The diffracted beam intensity is time dependent indicating a movement of the satellite position in the reciprocal space (i.e. the change of the wave vector of CDW-ordering). By measuring the profile of the satellite reflection, we found the temporal evolution of the satellite reflection occurs in the $(2a^*-c^*)$-direction. Figure 2 shows the the peak position and the width of the satellite. One finds two stable positons for the

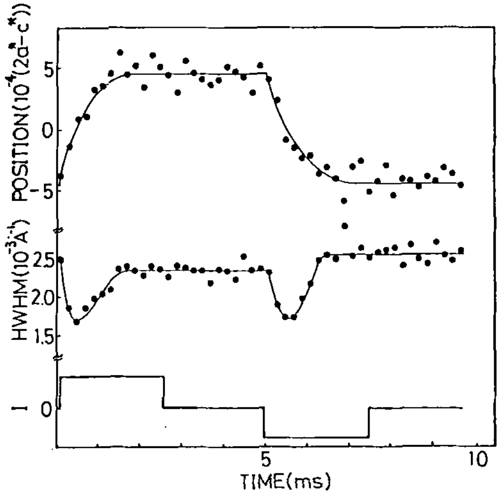

FIGURE 2 The position and the HWHM (half width at half maximum) of the satellite as a function of bidirectional current pulse.

positive and the negative polarities, respectively. These stable states are also seen by applying d.c. currents. The transient time from one state to the other is of the order of 1 ms, which seems to correspond to the electrical transient time. In the transient period the correlation length along the $(2a^*-c^*)$-direction deduced from the width of the satellite is longer than the detectable limit In the steady state, however, it is estimated to be ~500Å. The change in the CDW-ordering described above is most remarkably seen around 70K. Above 90K and below 40K no such change is observed.

The change of the wave vector in the direction of $(2a^*-c^*)$

indicates that the phase difference between CDW in the neighboring infinite layers of MoO_6 varies as a function of electric fields. Figure 3 depicts a possible configuration of CDW in real space. These two configurations may be caused by a field gradient in the sample. Field gradient results in the gradient of the force exerted to CDW by the field. Lack of the change in CDW-ordering above 90K may correspond to the decrease of the magnitude of the transient electrical relaxation above 100K.

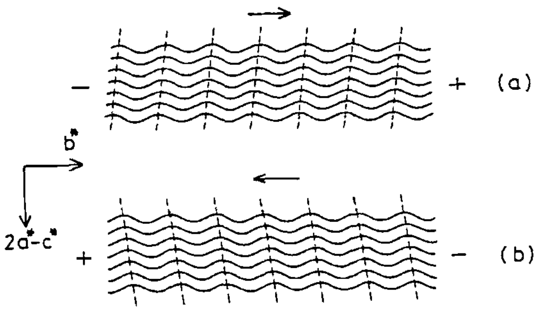

FIGURE 3 Possible configuration of CDW in real space. (a),(b) Each sinusoidal curve represents CDW in each infinite layer of MoO_6. Dotted lines show planes of the same phase. Arrows indicate the directions of the sliding of CDW.

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