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Photoconductivity and Electronic Structures of $CdCr_2Se_4$

Katsuaki SATO and Teruo TERANISHI

Broadcasting Science Research Laboratories of Nippon Hoso Kyokai ,Setagaya-ku, Tokyo

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Recently Berger *et al.*[1] and Wittekoek *et al.*[2] independently observed that the absorption edge of $CdCr_2S_4$ was not the semiconductor band edge but rather consisting of several types of absorption such as those due to charge transfer and crystal-field transitions.

To get a further information about the origin of absorption edge of chalcogenide spinels, photoconductivity measurements were carried out on the single crystals of $CdCr_2Se_4$. Undoped *p*-type crystals with the resistivity of the order of 10^8 ohm-cm were used for these measurements. Evaporated gold electrodes provided good ohmic contacts over the temperature range of measurements. Monochromatic light from a high-intensity spectrometer (Bausch-Lomb 33-86-03, 07) was chopped at 480 Hz and the photocurrent was detected by a narrow-band phase sensitive detector.

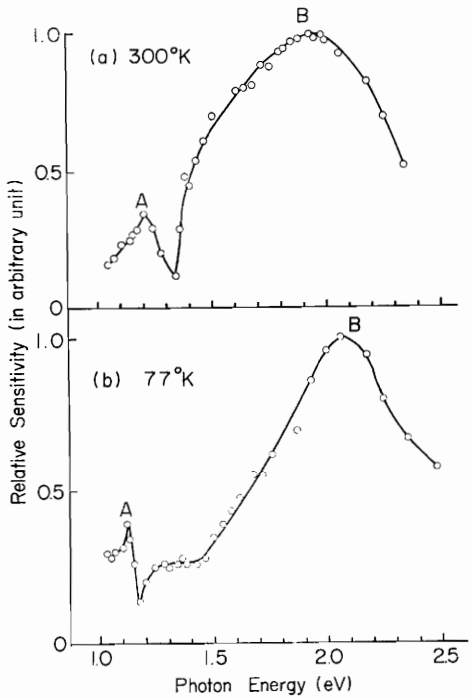

Fig. 1. Relative spectral sensitivity of the photocurrent, at 300°K (a) and 77°K (b).

The relative spectral sensitivity curves of the photocurrent are given in Fig. 1(a) and Fig. 1(b) for 300°K and 77°K, respectively. Two prominent peaks were observed, one at 1.25 eV (peak-A) and the other at 1.9 eV (peak-B) at room temperature. The peak-A is narrower and weaker than peak-B. In Fig. 2 energy of the peak-A is plotted against temperature. Peak-A moves toward lower energy (red shift), while peak-B slightly toward higher energy (blue shift) as the temperature is decreased.

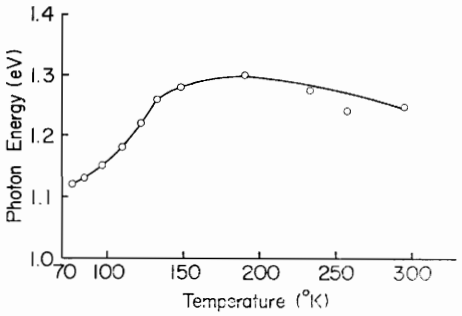

Fig. 2. Temperature shift of peak-A.

It is evident from these results that the peak-A is associated with the optical absorption edge reported by Harbeke *et al.*[3] The sharpness of this peak indicates that the corresponding transition is localized in character.

The broad and intense feature of the peak-B with its slight blue shift allows us to interpret this peak as originating from a direct band to band transition.

These interpretations are consistent with a preliminary measurement on the reflectivity spectrum of this material, which shows a prominent peak around 2 eV but not any such structure around 1.25 eV.

As the investigated samples were of *p*-type, negative magnetoresistance was not observed on the dark current, as was reported by Lehmann *et al.*[4] The photocurrent, however, showed this effect in the vicinity of the Curie temperature. This implies that the observed photocurrent is of electrons.

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