

ON RAMAN SCATTERING IN Cd–As DISORDERED THIN FILMS

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Room temperature Raman scattering in amorphous films with various Cd:As ratios was studied. The low frequency feature ($30\text{--}60\text{ cm}^{-1}$) is attributed to Cd–As and Cd–Cd vibrations. The high frequency one ($200\text{--}260\text{ cm}^{-1}$) is assigned to As–As vibrations.

1. INTRODUCTION

PRELIMINARY RESULTS OF the Raman scattering (RS) measurements on disordered Cd–As thin films of various chemical compositions are presented in this paper. The Cd:As ratios in these films are as follows: 50:50, 36:64, 33:67, 26:74 and 18:82. The films have been deposited by vacuum evaporation of the crystalline CdAs_2 and Cd_3As_2 onto the glass substrates at room temperature according to the procedure described in [1]. Then, they have been peeled off intact from the substrates and their thickness was of about $50\text{ }\mu\text{m}$.

2. EXPERIMENTAL

The RS spectra have been recorded in the back-scattering configuration with the incident light polarized horizontally, while the scattered one was unanalyzed. They were excited with $\lambda = 488\text{ nm}$ Ar^+ argon ion laser line of 100 mW power at room temperature. Before the measurements they were mounted inside the vacuum chamber of the cryostat.

3. RESULTS AND DISCUSSION

The strength of the RS in the films examined appeared to be quite small, as it was the case for $\alpha\text{-Cd}_3\text{As}_2$ crystals [2]. The RS spectra from the films with various Cd:As ratios are shown in Fig. 1 (2–6), while those from both amorphous $\text{Ga}_1\text{As}_{99}$ (1) and $\text{Ga}_{51.4}\text{As}_{48.6}$ (7) films being included for comparison. Two broad features within $30\text{--}60$ and $200\text{--}260\text{ cm}^{-1}$ frequency ranges are seen in the spectra 2–6. The former one corresponds rather well with the low frequency features in the $\alpha\text{-Cd}_3\text{As}_2$ RS spectra [2]. This is

reasonable since the tetrahedral coordination of the constituent elements in these films is close to that in the crystal counterpart [3, 4]. Then this feature is thought to reflect vibrational modes involving predominantly Cd–As and some contribution from Cd–Cd vibrations and corresponds to a broadened version of the crystal density of vibrational states. The high fre-

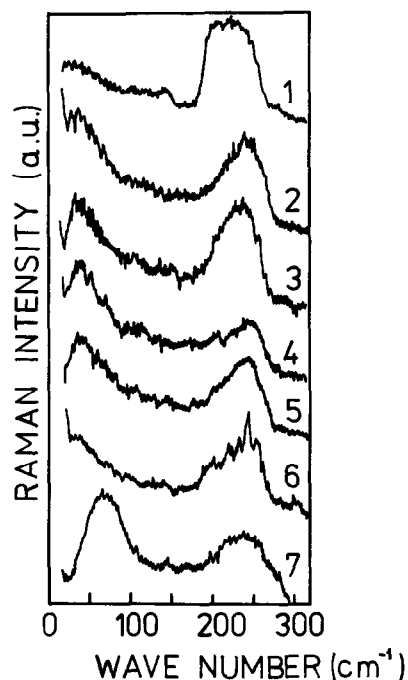


Fig. 1. Room temperature RS spectra from the disordered Cd–As thin films and Ga–As ones for comparison: 1 — $\text{Ga}_1\text{As}_{99}$, 2 — $\text{Cd}_{18}\text{As}_{82}$, 3 — $\text{Cd}_{26}\text{As}_{74}$, 4 — $\text{Cd}_{33}\text{As}_{67}$, 5 — $\text{Cd}_{36}\text{As}_{64}$, 6 — $\text{Cd}_{50}\text{As}_{50}$, 7 — $\text{Ga}_{51.4}\text{As}_{48.6}$.

quency feature, between 200 and 260 cm^{-1} , is highly influenced by the As excess, being the strongest for the $\text{Cd}_{18}\text{As}_{82}$ film and the smallest for the $\text{Cd}_{33}\text{As}_{67}$ one. Thus, it reflects the density of the vibrational modes involving As-As vibrations. This is consistent with the RDF and EXAFS data [4] for the films concerned which have shown that both Cd and As atoms are tetrahedrally coordinated in all the films. However, the coordination tetrahedra centred on both the Cd and As atoms have at their corners atoms of the either sort. Moreover, the mean number of the As atoms involved at the corner-sites of the tetrahedra centred on both the Cd and As atoms grows up with the increase of the As excess. This feature corresponds quite well with the ones observed in the same frequency interval in the RS spectra from both amorphous bulk As [5] and As thin films [6] and from $\alpha\text{-Ga}_1\text{As}_9$, as well. The mixed quasi-molecular and density-of-states character of the high frequency feature in the $\text{Cd}_{50}\text{As}_{50}$ film RS spectrum (6) probably arises from local As atoms arrangements resembling As_4 molecule (peaks at about 200 and 240 cm^{-1}). The others at about 220, 260 and 300 cm^{-1} might be as-

signed to variations in both As-As-As bond angle and topology [6].

Further studies of the RS in the disordered Cd-As system thin films are in progress and their results will be published elsewhere.

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REFERENCES

1. A. Burian, B. Rzepa, P. Lecante & A. Mosset, *J. Mater. Sci. Lett.* **4**, 701 (1985).
2. J. Wieszka, M. Renucci & A. Zwick, *Phys. Status Solidi. (b)* **133**, 57 (1986).
3. Lin Chung, *Phys. Rev.* **188**, 1272 (1969).
4. A. Burian, P. Lecante, A. Mosset & J. Galy, to be published.
5. J. Nemanich, G. Lucovsky, W. Pollard & J.D. Joannopoulos, *Solid State Commun.* **26**, 137 (1977).
6. J. Lannin, *Phys. Rev.* **B15**, 3863 (1977).