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# X RAY ANALYSİS OF InAs-CrAs EUTECTİC SYSTEMS

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## ABSTRACT

InAs-CrAs systems are synthesized by the vertical Bridgman–Stockbarger method. XRD analysis and microstructural study of InAs-CrAs composites show that CrAs metallic inclusions are uniformly distributed in the InAs matrices.

**Keywords:**XRD, SEM and EDX analysis, eutectic alloy.

## 1. INTRODUCTION

Diluted magnetic semiconductor materials based on A3B5 compounds and 3d-metals eutectic composites, having a stable composition and properties,are promising materials for spintronic devices. One of the main features of eutectic composites obtained based on InAs, InSb, GaSe and 3d - transition elements is the anisotropy in kinetic coefficients depending on the direction of metal needles. [1-2]. These composites, which combines both semiconductor and metallic properties, behave as nonhomogeneous semiconductors since metal needles are distributed parallel to the crystallization direction. The composites formed by the 3d-transition metals are considered to be diluted magnetic semiconductors. Recently, the recent discovery of superconductivity in chromium arsenide CrAs has attracted a lot interest [3] because this material has been synthesized looking for superconductivity on the verge of the antiferromagnetic order by means of the application of external pressure. According to the results of these studies, the connection between the ferromagnetic constituents perpendicular to the crystallization axis in the CrAs junction is antiferromagnetic. Consequently consideration of the InAs-CrAs systems is of substantial interestl [4-7]. The present paper is devoted to synthesis and structure investigated of InAs-CrAs systems.



## 2. EXPERIMENTAL

InAs-CrAs eutectic alloys were prepared by using the vertical Bridgman method. The rate of the crystallization front was about (0.6÷1.2) mm/min. XRD intensity data were collected on an Advance-D8 diffractometer using CuKα radiation. Scanning Electron

Microscope (SEM), equipped “Oxford EDS” и “HKL EBSD”, were used to characterize the morphology of the specimens and to obtain qualitative information on the elemental composition of the samples, respectively.

## 3. RESULTS AND DISCUSSION

Diffraction patterns of InAs-CrAs eutectic composite are shown in Fig. 1. These figures also show data on the diffraction patterns for InAs and CrAs compounds. Analysis of XRD spectra confirmed that this system is diphasic: the most intense peaks corresponding to the (101), (200), (112), (121), (220), (004), (301), (123), and (312) Muller index are identical to the InAs matrix, while the weak peaks found at 2θ = 29.6 º, 44.08º, 52.2º, and 69.13º coincide with the CrAs lines having a orthorhombic structure.

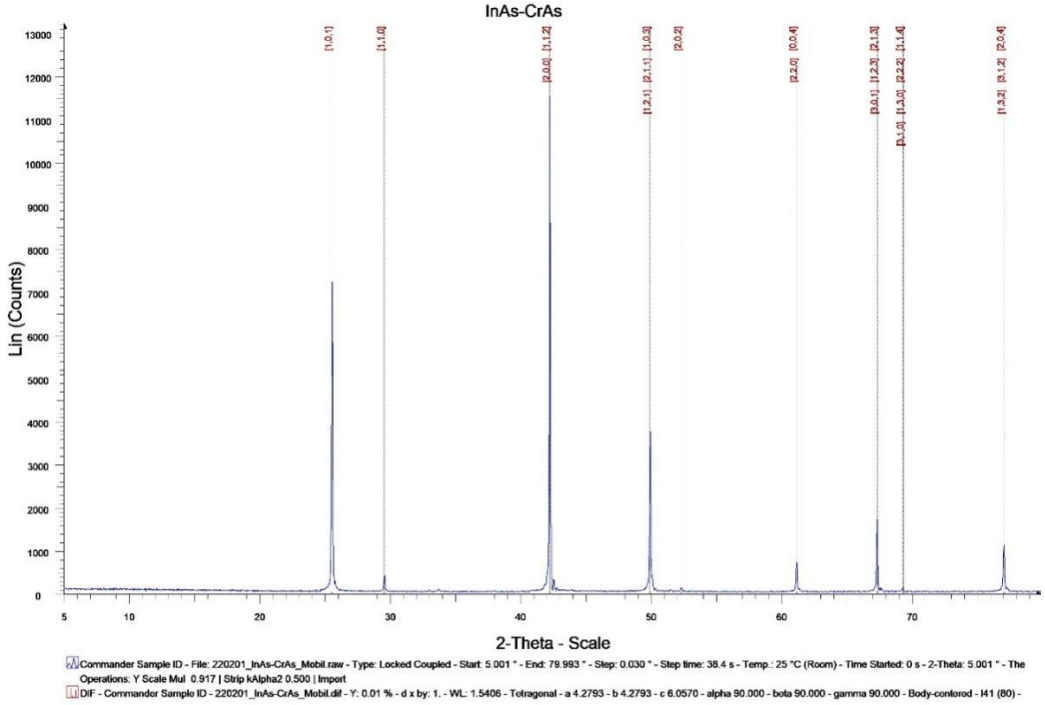


Fig.1. X-ray spectrum of InAs-CrAs eutectic composite.

Based on SEM examinations (Figs.2), the needle-shaped metallic inclusions with a diameter of about 0.6-1.5 μm, a length of 20÷50 μm and a density of ~5.8x$10^4$ $mm^{-2}$ are uniformly and parallel distributed in the InAs matrix.

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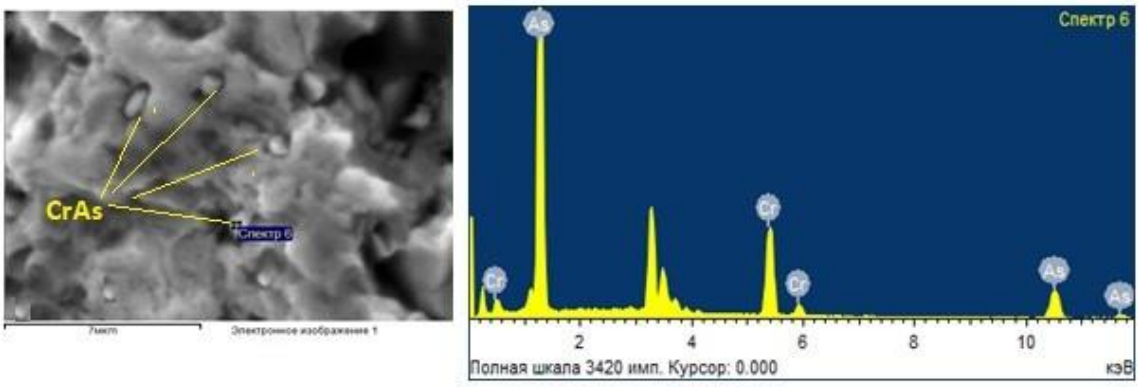


Fig. 2. SEM micrographs of InAs-CrAs showing cross sections of the samples along the lateral directions of the CrAs phase

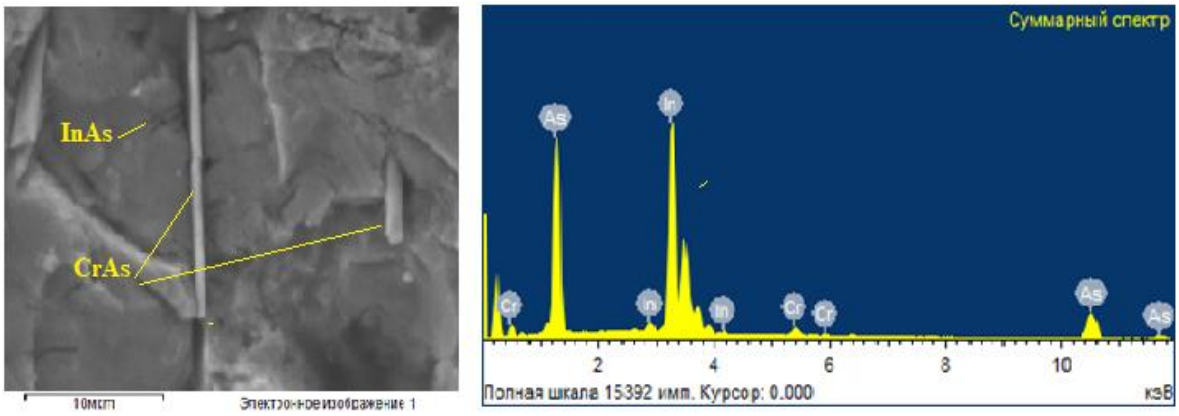




Fig.3. X-ray spectra of InAs-CrAs obtained with SEM–EDX from the needle and matrix phases along the lateral directions of the specimens

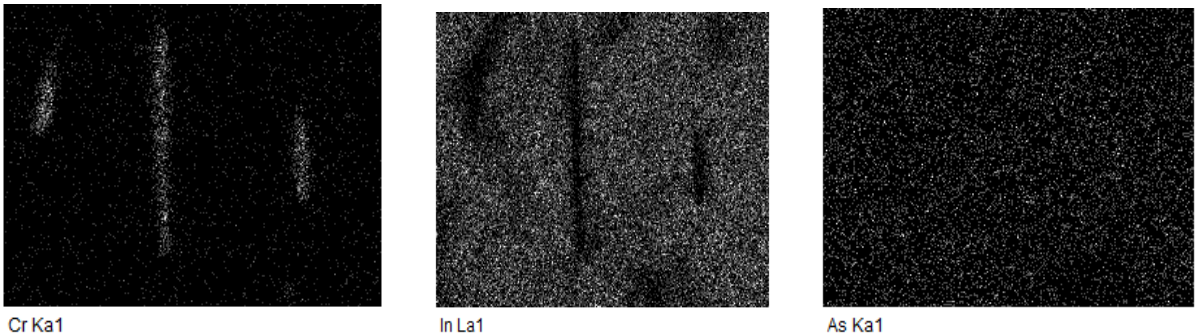


Fig.4. Element map of the InAs-CrAs composite

It was found that the matrix contains In = 63.2wt%, As= 36.8 wt% (Fig.3, spectrum 1), the inclusion are contained Cr = 17.8 wt%, As = 82.2 wt% (Fig.3, spectrum2). The data correspond to the stoichiometric composition of the matrix and inclusions. Fig.4 shows

elemental maps of Cr, In and As from the cross sections along the lateral direction of the needle phases, respectively and black colour indicates the absence of this element.

## 4. CONCLUSIONS

XRD, SEM and EDX analysis show that the obtained composites present two phase system, so that the observed intense peaks are related to the InAs matrix and weaknesses - to the CrAs inclusions. The two phaseness of the InAs-CrAs composite have been confirmed by the microstructure and morphology studies.

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