Powder X-ray diffraction study of $Cd_{1-x}Mn_xTe$ solid solution

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Introduction:

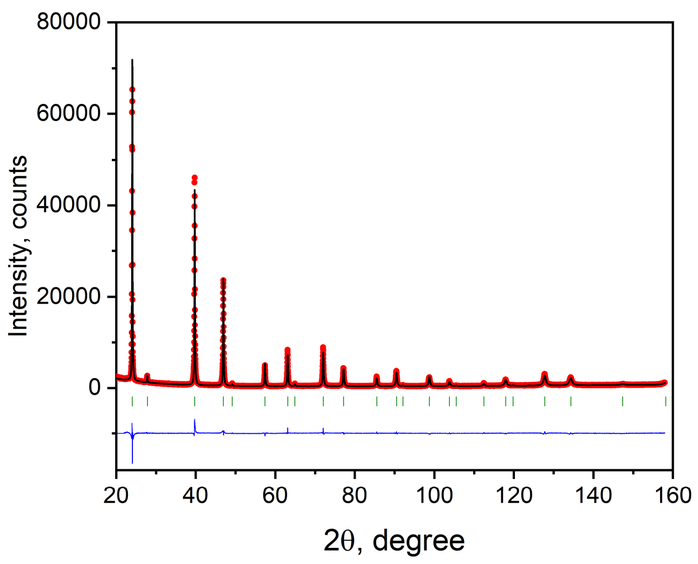
The $Cd_{1-x}Mn_xTe$ crystals belong to the II-VI based dilute magnetic semiconductors. These materials arouse the investigators interest due to their pronounced magnetic and magneto-optical properties and because of new possible application in spintronic devices[1] and X and gamma ray detectors[2,3]. Despite the fact that at ambient conditions $Cd_{1-x}Mn_xTe$ their zinc blende crystallographic structure is well-known [4], the knowledge of some aspects of its crystallographic characteristics is limited.

Sample preparation:

The $Cd_{1-x}Mn_xTe$ crystals with Mn concentration $0 \le x \le 0.4$ were obtained by using the low pressure Bridgman method. The very high purity (6N) elements (Cd, Mn and Te) prepared in the Institute of Physics were used by us for for growth of the studied single crystals.

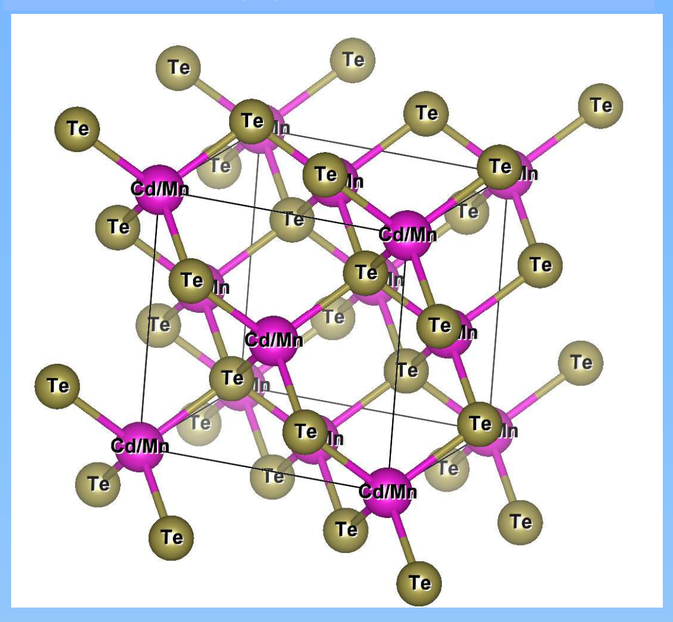
Measurements:

Powdered samples were measured by X-ray diffraction technique and then analyzed by Rietveld method[5]. (Fig.3) All refinements were performed with accuracy not worse than R_{wp}=15%.



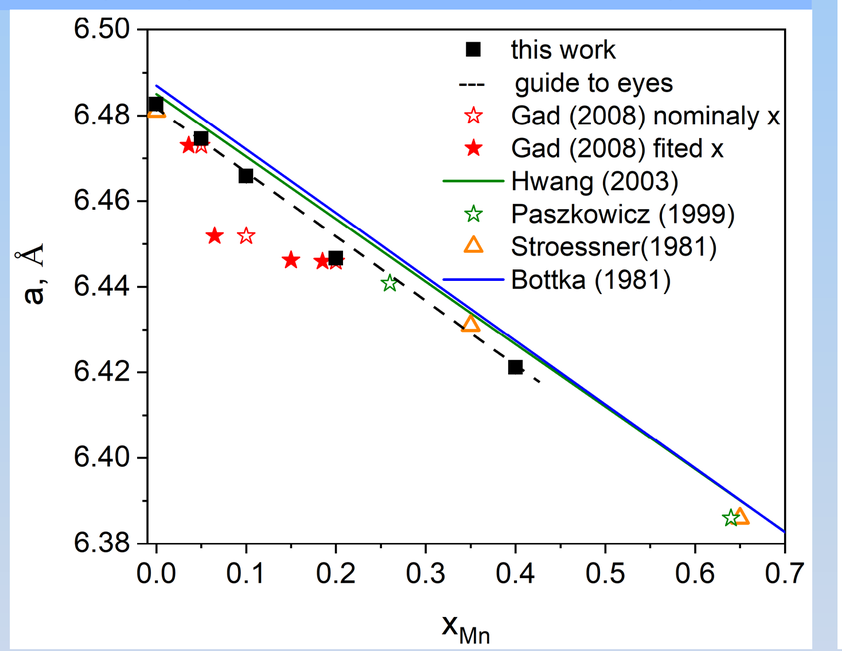
(Cd, Mn)Te structure:

All investigated samples have zinc blende type crystallographic structure and do not content any phases.



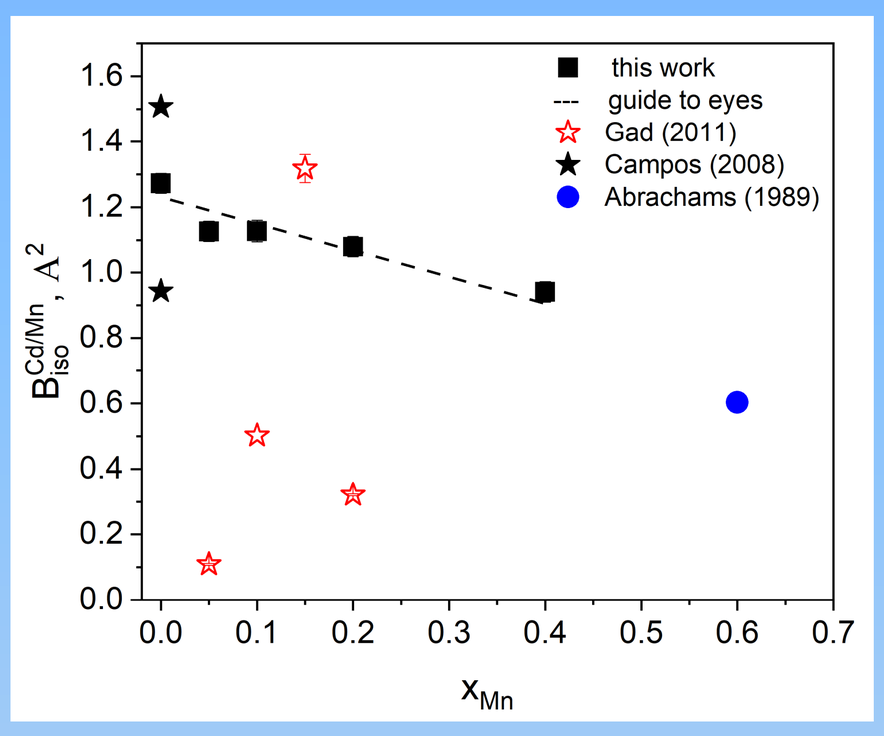
Lattice parameters :

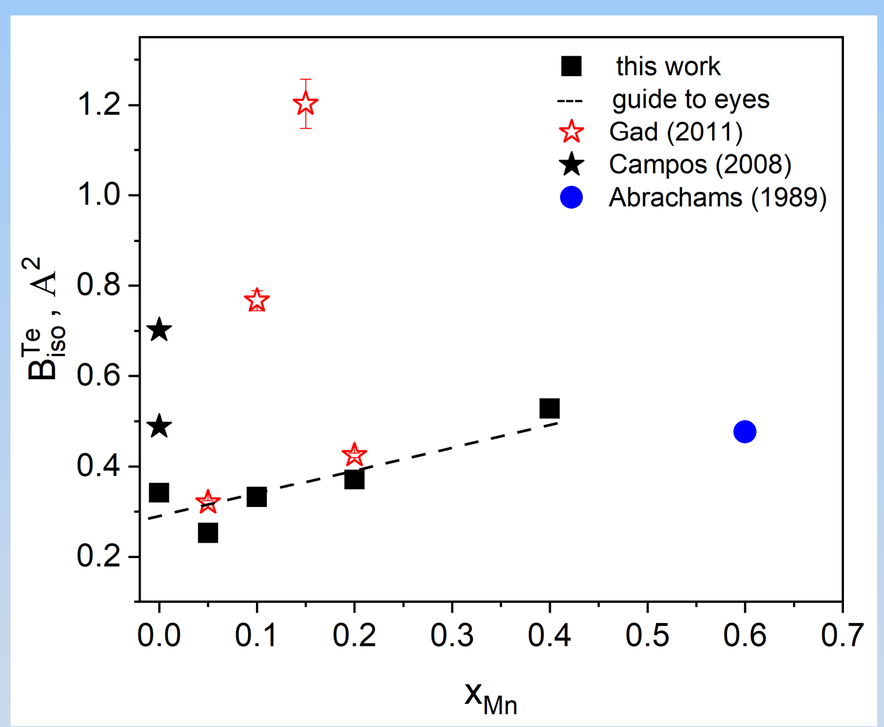
Lattice parameters dependence on Mn-content is in good agreement with previous literature data[6-8, 11]. In particular, the a(x) variation is very close to that of Bottka (1981) linear equation: 6.487-0.149x (Å).



Isotropic Debye-Waller factor:

The present data indicate that changes in function B(x) for both, cations and anions, have a discernible opposite tendencies. As illustrated in Figures below, the data reported in the literature show a high scatter between 0.1 and 1.5 Å^2.





Summary:

- The phase purity and crystallographic structures of the $Cd_{1-x}Mn_xTe$ crystals with Mn concentration up to 40% in ambient conditions by X-ray diffraction were established.
- The lattice parameters variations as well as the Mn -concentration dependence of isotropic Debye-Waller factor data, *B*(x), for anion and cation atoms were refined.
- In has been found that in (Cd,Mn)Te solution the *B*(x) function has decreasing tendency for cation atoms and opposite tendency is observed for anion atoms.

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