Atomic Image around Mn Atoms in Diluted Magnetic Semiconductor $Zn_{0.4}Mn_{0.6}Te$ Obtained by X-ray Fluorescence Holography

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Recently, diluted magnetic semiconductor $Zn_{1-x}Mn_xTe$ has attracted much attention as a spintronic material. From an X-ray diffraction [1], the lattice constant of $Zn_{1-x}Mn_xTe$ linearly changes with varying x (Vegard's law), while an XAFS results [2] showed almost unchanged Mn-Te and Zn-Te bond lengths (Pauling's rule). This discrepancy led to a question of how the large $MnTe_4$ tetrahedra can be squeezed into the small $ZnTe_4$ lattice.

X-ray fluorescence holography (XFH) is a new technique that allows one to investigate a three-dimensional local image around a specific element. The sample was irradiated by intense X-rays of certain energies beyond the Mn-*K* absorption edge at BL37XU/SPring-8 in order to obtain the Mn-*K* fluorescence hologram [3]. A three-dimensional atomic image around the Mn central atoms was derived from the holograms using Barton's algorithm, as shown in Fig.1. The nearest- and third-nearest-neighbor Te atoms are clearly visualized. However, the second-nearest-neighbor Zn or Mn atoms are barely visible in this image due probably to a highly distorted cation Zn(Mn) sub-lattice.

[1] Yorder-Short D.R. *et al., J. Appl. Phys.* **58**, 4056 (1985). [2] Happo N. *et al., J. Phys.: Condens. Matter* **8**, 4315 (1996). [3] Hosokawa S. *et al., Jpn. J. Appl. Phys.* **44**, 1011 (2005).

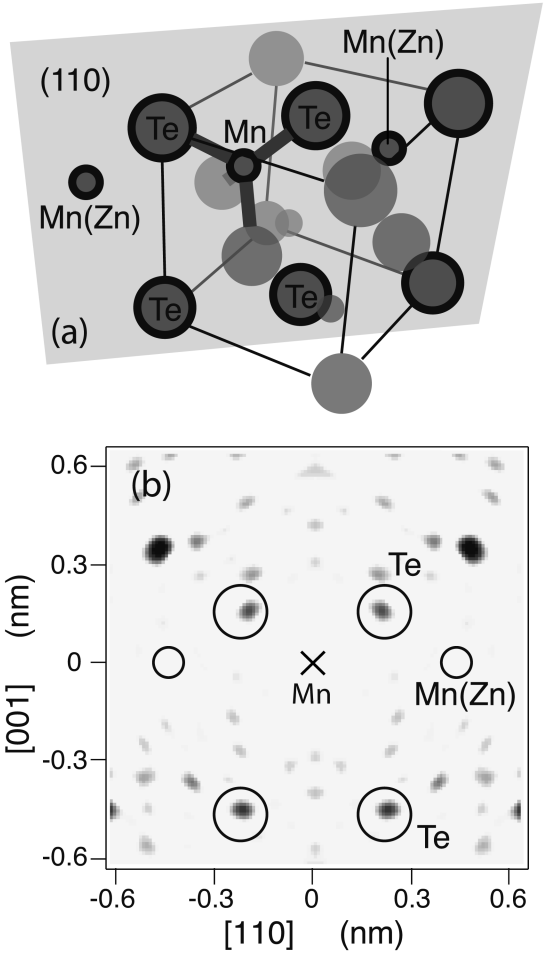

Fig.1 Schematic view of $Zn_{1-x}Mn_xTe$ crystal (a), atomic image around Mn atom on the (110) plane obtained from the present XFH experiments (b). Large and small circles indicate the anions (Te) and the cations (Zn or Mn).