We present the results of the electronic band structure study of the \( \text{Ge}_{0.9}\text{Mn}_{0.1}\text{Te} \) epilayers, clean and modified \textit{in situ} by deposition of manganese atoms under ultra high vacuum conditions. \( \text{Ge}_{1-x}\text{Mn}_x\text{Te} \) is a ferromagnet with a relatively high Curie temperature (up to 140 K) strongly depending on Mn concentration [1]. Thus, investigation of its properties, including the band structure, attracts considerable interest, in view of possible applications of IV-VI-based systems in fabrication of spintronic devices.

The \( \text{Ge}_{0.9}\text{Mn}_{0.1}\text{Te} \) layers were grown on \( \text{BaF}_2 \) (111) substrates by an MBE method with use of effusion cells as \( \text{GeTe}, \text{Te}_2 \) and Mn solid sources. The substrate temperature was 400-450 °C. The content of Mn in \( \text{Ge}_{0.9}\text{Mn}_{0.1}\text{Te} \) was checked by energy dispersive X-ray fluorescence analysis. The sample surface was protected by a layer of amorphous tellurium. Prior the photoemission experiments, the tellurium layer was removed by annealing. The Mn overlayers were deposited \textit{in situ} at room temperature. The valence band and shallow core levels of \( \text{Ge}_{0.9}\text{Mn}_{0.1}\text{Te} \) and ultrathin Mn overlayers have been investigated by means of resonant photoemission spectroscopy (RPES). In this technique the radiation energy is tuned to the intra ion transition (like Mn 3p-3d) in order to enhance emission from partly occupied shells of transition metal atoms.

Sets of resonant photoemission spectra were measured for the photon energy range covering the energy of the Mn 3p→3d transition (40<\( h\nu <60 \) eV). They were acquired for the clean surface of the \( \text{Ge}_{0.9}\text{Mn}_{0.1}\text{Te} \) sample, after evaporation of 0.5 ML Mn and after annealing at 200°C for 2 hours. The annealing was carried out in order to induce the diffusion of Mn atoms into the \( \text{Ge}_{0.9}\text{Mn}_{0.1}\text{Te} \) crystal. The spectra (photoelectron energy distribution curves) covered the range of electron binding energy starting from the valence band edge down to the Mn 3p level. The Mn 3d states contribution occurred in the upper part of the valence band, with a maximum at the binding energy of about 4 eV. Its shape corresponded to that expected for Mn\(^{2+}\) ions surrounded by six Te ions in the octahedral coordination [2]. Deposition of Mn and annealing the system led to an increase of Mn 3d feature intensity but did not induce any change in the shape of the spectrum. This proved that diffusing Mn ions occupied the same sites in the lattice as those introduced during the layer growth.

The results acquired for the \( \text{Ge}_{0.9}\text{Mn}_{0.1}\text{Te} \) epilayers are compared with those recently obtained for bulk \( \text{Ge}_{1-x}\text{Mn}_x\text{Te} \) polycrystals in which Mn possibly forms a mixed valence system [3]. The photoemission results are also related to perceptible differences in magnetic properties of theses two systems.


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