Structural analysis via Raman spectroscopy of Cu-doped CdMnTe

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Even not being used by the industry in manufacturing of main components for electronic devices, due to its high resistivity, CdTe is a semiconductor with optical properties that allowed it to be used in the manufacture of solar cells and electromagnetic wave detectors in the visible region of the spectrum. CdMnTe, a dilute magnetic semiconductor-DMS based on CdTe, is a material also widespread in the market due to its optical properties. CdMnTe is applied in optical isolators and electromagnetic field sensors for ultraviolet, x-ray and gamma. Despite presenting a magnetic element in its composition (Mn), the CdMnTe has not yet presented a ferromagnetic phase like GaMnAs, another DMS that has structural properties similar to CdMnTes. The absence of this phase can be explained by the absence of charge carriers in the CdMnTe, since the Mn supplies charge carriers when inserted in the GaAs, but not for the CdTe. In this work, we studied changes that the introduction of Cu as dopant could trigger in the structural and electrical properties of the CdMnTe. We doped a thin film of CdMnTe by depositing a small amount of Cu on its surface, followed by a thermal treatment, where sufficient thermal energy was supplied for Cu to diffuse in the CdMnTe. Since this doping technique is already used to lower the resistivity of CdTe by solar cell industries, and CdMnTe has many of its properties similar to CdTes, this method has proven to be a viable option since all procedures for growth and doping could be carried in the UFV physics department. We used the molecular beam epitaxy-MBE technique to perform the growth of the samples, which passed through different stages of the doping process, allowing us to follow the modifications caused by each step alone and together. Next, measurements of Raman spectroscopy, X-ray diffraction-XRD and resistance under low temperatures were performed. The Raman spectroscopy measurements showed CuTe formation in the doped material, which influenced the change from an unstable phase of the material to a more stable phase. XRD measurements presented changes in the original structure of the CdMnTe, among which the decrease of the lattice size of the majority structure in the material can be observed. Preliminary electrical measurements showed the decrease in resistivity of the material in six orders of magnitude, maintaining the characteristic curve of a semiconductor material when subjected to low temperatures, when compared to non-doped samples.