**Summary**

Bi2Te3 is a rhombohedral layered structure with three five-layer groups with the sequence Te1–Bi–Te2–Bi–Te1 and space group R3m . For compounds such as Bi2Te3 doping with Ge leads to the formation of continuous series of 1D superstructures that are built up of sequences of five- and seven-layer lamellae. Despite the importance of the material for thermoelectric applications no systematic microstructural investigations can be found in the literature for Bi2Te3 materials and related systems. Specimens suitable for cross-section observations (with the electron beam parallel to the layer planes) were prepared from crystals of Bi2Te3Gex with x taking the values of 0.18 and 0.26 and subsequently thinned by ion beam bombardment in order to be studied by means of electron microscopy techniques. The diffraction pattern yields an easily recognizable fine structure. However, apart from the known modulated superstructures along the c-Bi2Te3 other incommensurately modulated phases exist and cause the splitting of the spots along directions non-parallel to the c-axis. This splitting is correlated with a structural modulation, which is present in all parts of the sample in the form of a displacement field, as it is revealed by the HRTEM images. The nature of the structural modulation was analyzed and was attributed to a network of dislocations that deforms plastically the crystal structure. Measurements with EDS revealed a small amount of inhomogeneous chemical composition of Ge but this chemical modulation can only be considered as a secondary mechanism for the formation of the modulations. However, the modulations might be regarded as an intermediate state between pure crystalline and amorphous due to the tendency of Te compounds to form amorphous phases and its presence might be controlled by the thermal history of the sample. Nevertheless, the modulations seem to reduce the thermal conductivity of the materials due to the scattering of the phonons that leads to anisotropic transport coefficients enhancing thus the thermoelectric efficiency of the material.

Keywords: Modulated structures, TEM, HRTEM, Bi2Te3, nanostructure, EDS, thermoelectric properties