Mechanisms of current transport in anysotype heterojunctions n-TiN/p-CdZnTe

Mykhaylo M. Solovan, Viktor V. Brus, Pavlo D. Maryanchuk, Maria I. Ilashchuk, Kostyantyn S. Ulyanitskiy

Yuri Fedkovych Chernivtsi National University, 2 Kotsyubynsky str., 58012 Chernivtsi, Ukraine, e-mail: m.solovan@chnu.edu.ua

Titanium nitride (TiN) and solid solutions based on cadmium telluride (CdZnTe) are prospective for the application in different photoelectrical devices due to their electrical and optical properties.

This work is focused on the investigation of the dominating current transport mechanisms in the heterojunctions, fabricated by the deposition of TiN thin film by the DC reactive magnetron sputtering technique onto CdZnTe single crystal substrates.

The deposition of the n-TiN thin films was carried out onto the freshly cleaved surface of CdZnTe single crystal (with dimensions 5×5×1 mm) in a universal vacuum setup Laybold – Heraeus L560 by means of the DC reactive magnetron sputtering of the pure titanium in a mixture of argon and nitrogen gases.

The CdZnTe substrates were mounted over the magnetron with the further rotation in order to provide the uniform thickness of the films. Before the start of the deposition process the vacuum chamber was pumped down to the pressure of the residual gases 5×10^{-5} mbar.

The formation of the gas mixture from argon and nitrogen in the necessary ratio was carried out from two different sources during the deposition process.

The partial pressures of argon and nitrogen were 3.5×10^{-3} mbar and 0.7×10^{-3} mbar, respectively. The magnetron power was 120 W. The substrate temperature was 573 K during the deposition process. The duration of the deposition process was 15 min.

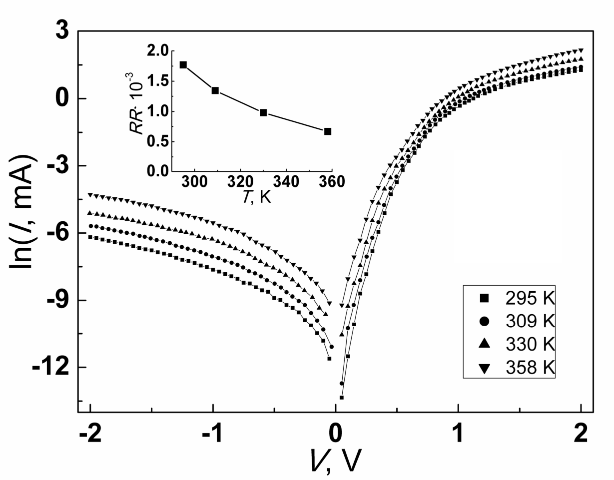

Fig. 1. I-V characteristics of the n-TiN/p-CdZnTe heterojunctions at different temperatures. The inset shows the temperature dependence of the rectification ratio.

Current-voltage characteristics of the n-TiN/p-CdZnTe heterojunctions (fig.1.) were measured by means of a measuring complex SOLARTRON SI 1286, SI 1255.

The analysis of the heterojunctions under investigation has shown that the dominating current transport mechanism at forward bias is determined by the generation-recombination processes within the space charge region via deep energy levels assisted by interface states at the TiN/CdZnTe heterojunction interface. The analysis of the current transport mechanisms at reverse bias has shown that dependence $I_{rev}(V)$ is well described in the scope of the tunnel model.