Contact resistance and mechanical property measurements for the $Ge_2Sb_2Te_5$ thin films

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Currently, $Ge_2Sb_2Te_5$ (GST225) is widely investigated as material for non-volatile phase change memory. However, for the successful implementation of the multi-layered memory cell, it is necessary to understand peculiarities of interaction between GST225 and adjacent layers. In this regard, in the present work the contact resistances of the different contact pads to the GST225 thin films and mechanical properties of the GST225 films on the different sublayers were investigated.

GST225 thin films were deposited by magnetron sputtering. The composition of the obtained films was determined by Auger spectroscopy, and was close to the sputtered material.
To measure the $Ge_2Sb_2Te_5$ specific contact resistance (ρ_c), the transfer line method with the linear geometry of the contact pads was used. The materials of the electrodes were Ti, Ni, Al, TiN + W. For all samples, symmetric linear current-voltage characteristics were obtained, which confirms the Ohmic contacts. Measurements in the temperature range from 30 to 300 °C made it possible to determine the temperature dependence of the ρ_c. A drop in contact resistance from $1 \cdot 10^6$ to $3 \cdot 10^1$ Ohm·cm^2 was detected.

Mechanical properties were investigated by nanoindentation of $Ge_2Sb_2Te_5$ layers on Si substrate with different sublayers (Al, TiN, TiN+W, TiN+W, NiCr). The nanoindentation measurements were performed using Berkovich indenter attached to a nanoindenter (B-J53). It has been established that GST225 films on the TiN + W and TiN sublayers have the highest, while on the Al the lowest hardnesses.

Adhesion propertied of $Ge_2Sb_2Te_5$ layers were studied by atomic force microscopy (AFM Multimode Nanoscope (IV) MMAFM-2) scratch-tests. It was determined that Al and NiCr sublayers have the highest adhesion to GST225 films.
So, in the present work, the temperature dependences of the contact resistance were measured and the mechanical properties were studied.

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