Current-voltage characteristics of *n*-TiN/*n*- $Hg_{1-x-y}Cd_xMe_ySe$ heterojunctions

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Currently various prospective semiconductor materials and structures based on them are under intensive research for their application in electronics and photovoltaics. The application of heterojunctions for the fabrication of photoelectrical converters enhances their operational characteristics comparing with those for photoelectrical devices based on homojunctions [1].

Titanium nitride (TiN) thin films are of wide application in different semiconductor devices [2] due to the optimal combination of physical and chemical parameters: low specific resistance, high transparency within the visible range, high reflectance in the infrared part of spectrum, high hardness, high wear resistance, good chemical inertness and resistance to corrosion.

This work is focused on the investigation of current-voltage characteristics of heterojunctions *n*-TiN / *n*-$Hg_{1-x-y}Cd_xMe_ySe$ (where Me - Eu, Gd, Dy, that are the elements with unfilled 4*f* shell), formed between the bulk crystal $Hg_{1-x-y}Cd_xMe_ySe$ and TiN thin film, deposited by reactive magnetron sputtering.

The deposition of the *n*-TiN thin films was fulfilled on the polished surface of the crystals $Hg_{1-x-y}Cd_xMe_ySe$ (standard size ~ 7×7×1,5 mm) in the universal vacuum system Laybold - Heraeus L560 by means of reactive magnetron sputtering target in an atmosphere of pure titanium mixture of argon and nitrogen at a constant voltage.

The $Hg_{1-x-y}Cd_xMe_ySe$ substrates were placed on magnetron, followed by rotating of the table to ensure uniformity of film thickness. Before the deposition process vacuum chamber was pumped down to the pressure of the $5 \cdot 10^{-3}$ Pa.

The formation of the gas mixture of 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 7×10^{-3} mbar, respectively. The magnetron power was 120 W. The substrate temperature was 300 K during the deposition process. The duration of the deposition process was 15 min.

Ohmic contacts to heterojunctions were fabricated by thermal evaporation of indium at substrate temperature of 150 ° C.

Due to high carrier concentration in the base material in the structures under research space charge region and its thickness are inversely proportional to this concentration of charge carriers. Because of the high concentration the space charge region is narrow and therefore electrons can tunnel through it. As a result straightening is not observed in the current-voltage characteristics because electrons freely tunnel through a narrow space charge region.

[1] Alferov Zh.I. 1998 *Semiconductors* **32** 1.
[2] Vinokur V.M., Baturina T.I., Fistul M.V., Mironov A.Yu., Baklanov M.R and Strunk C. 2008 *Nature* **452/3** 613.