Features of current flow in the $CoFe_2O_4$/*n*-CdTe heterojunction

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The $CoFe_2O_4$/*n*-CdTe heterojunction was produced by growing thin films of $CoFe_2O_4$ cobalt ferrite with a thickness of $w \approx 0.5$ μm on the surfaces of *n*-CdTe substrates by the spray pyrolysis method. Spray pyrolysis was carried out under conditions of atmospheric pressure at a substrate temperature of T_S = 350 ºC. A mixture of 0.1 M solutions of $CoCl_2 \cdot 6H_2O$ and $FeCl_3 \cdot 6H_2O$ salts in the Fe/Co = 2 ratio in bidistilled water was used to generate the aerosol. During the pyrolysis of salts, cobalt and iron interact with atmospheric oxygen, resulting in the formation of a film of cobalt ferrite $CoFe_2O_4$ with weak *n*-type conductivity and high resistivity ($\rho \approx 10^7$ Ω·cm) at room temperature. According to studies of light transmission of $CoFe_2O_4$ films in the visible region on a SF-2000 spectrometer, calculation and analysis of the spectral dependence of the absorption coefficient, the band gap width of $CoFe_2O_4$ films produced by spay pyrolysis is $E_g \approx 2.3$ eV and is in good agreement with literature data [1]. Ohmic contacts to low-resistance *n*-CdTe crystals were made by indium infusion. Contacts to the $CoFe_2O_4$ film were created using silver-based conductive paste. The *I-V*-characteristic of the $CoFe_2O_4$/*n*-CdTe heterojunction has diode properties (Fig. 1). The rectification ratio at T = 293 K is $3 \cdot 10^5$ (at voltages $|V|$ = 1.5 V). According to the temperature dependence of the *I-V*-characteristics in the range of forward biases for which the coefficient of non-ideality is close to unity ($n \approx 1.35$), the height of the potential barrier qV_b = 0.8 eV was determined (Fig. 1, inset).

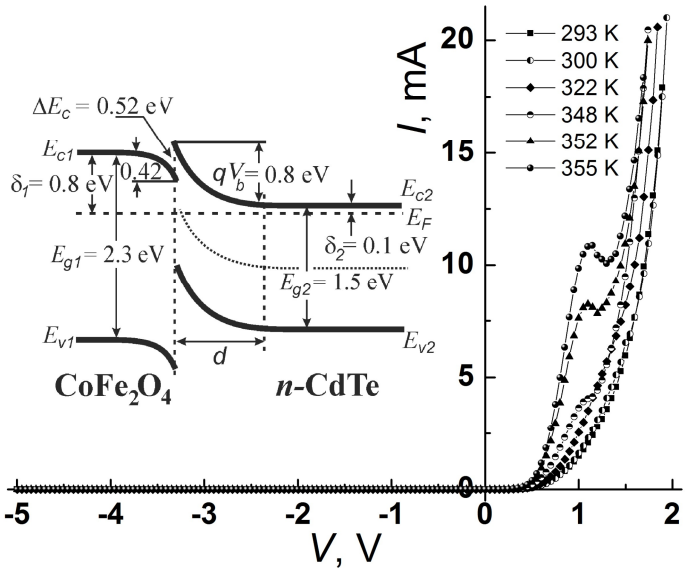

Fig. 1. *I-V*-characteristic and energy diagram (inset) of the $CoFe_2O_4$/*n*-CdTe heterojunction

At forward biases of $3kT/q < V < 0.5$ V, an over-barrier current flows in the $CoFe_2O_4$/*n*-CdTe heterojunction, and at forward voltages of 0.5 V < V < 1 V, electrons tunnel through the heterojunction barrier in the conduction zone. Tunneling is carried out with the participation of energy states in the band gap of *n*-CdTe near the contact with the $CoFe_2O_4$ film. At temperatures higher than 348 K (Fig. 1), a negative differential resistance is observed. This is due to a decrease in the concentration of electron-free energy states as the temperature increases, to which electrons from the *n*-CdTe conduction zone can move and then tunnel into the $CoFe_2O_4$ conduction zone. At the same time, the forward current decreases and is restored to its previous value at higher voltages. At reverse biases -3 V < V < $-3kT/q$, a generation mechanism of current generation due to thermal generation of charge carriers is observed in the *n*-CdTe region depleted of the main charge carriers.

[1] V.A. Jundale, G.Y. Chorage, A.A. Yadav, *Mater. Today Proc.* **43**, 2678 (2021).