FORMATION OF FERRITE FILMS $NiFe_2O_4$ BY SPRAY PYROLYSIS OF CHEMICAL SOLUTIONS $NiCl_2{\cdot}2H_2O$ AND IRON TRICHLORIDE $FeCl_3{\cdot}6H_2O$ ON AN INDIUM SELENIDE SUBSTRATE

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Ferrite thin films are interesting materials that have been studied for decades due to their special properties: electrical and magnetic, high chemical and mechanical hardness, radiation resistancewhich creates opportunities for their wide use in various types of devices. Ferrite thin films have numerous applications, such as magnetic recording media, magnetoelectric composites, sorbents for organic pollutants, microwave devices, gas sensors, transformers, magnetic coil core, hydrogen production, batteries, and many others. Spinel ferrites of the MFe_2O_4 type (M = Ni, Co, Zn and others) have interesting physical properties that are widely used in practice and described in various studies. In particular, cubic inverse spinel $NiFe_2O_4$ (NFO) is a promising candidate in many areas of electronics due to the peculiarities of the arrangement of atoms in the crystal lattice. It is important to prepare the film, the correctness and method of its application, which directly affects the characteristics of the film and the structures created on its basis. The spray pyrolysis method is widely used due to the simplicity of the process, low cost and efficiency for the development of large-area ferrite films. In addition, various advantages of the spray pyrolysis technique include convenience of coating, low energy consumption for sample preparation and film thickness control, etc. This technique involves the fabrication of multicomponent thin films from different aqueous mixtures, of which at least two mixtures are mixed to form a solution. This makes it possible to effectively dope the films by changing the quantitative composition of the raw materials. Film uniformity, controlled grain size, etc. can be achieved using this method.

Monocrystalline n-InSe grown by the Bridgman method was used to manufacture heterojunctions. From the InSe crystal ingot, plane-parallel plates $3{\times}3{\times}1.2$ mm^3, which had perfect mirror surfaces, were chipped along the cleavage plane. Chipping was carried out in the air. $NiFe_2O_4$ thin films were produced by spray pyrolysis of a 0.1 M aqueous solution of nickel dichloride $NiCl_2{\cdot}2H_2O$ and iron trichloride $FeCl_3{\cdot}6H_2O$. Distilled water was used to dissolve metal salts. Separately prepared solutions of nickel and iron salts were mixed in the proportion of Fe:Ni = 2:1 by volume using a magnetic stirrer for 60 minutes at room temperature before application. The pyrolysis temperature when obtaining samples of $NiFe_2O_4$ thin films on substrates was T_S = 623 K. Compressed air was used as the carrier gas. The spray pyrolysis process allowed simultaneous application of films on several substrates. To obtain the steps of the film, which were used in determining the thickness, specially made masks were used. The thickness of the n-$NiFe_2O_4$ films was ≈ 0.2 μm. It was determined by the displacement of interference lines at the film-substrate boundary using the Linnyk MII-4 microinterferometer.