STRUCTURAL PECULIARITIES OF PIEZOELECTRIC OXIDE ZINC THIN FILMS PREPARED IN MAGNETRON ION-PLASMA REACTORS ON DIRECT CURRENT

A.A. Veselov, A.G. Veselov, Yu.A. Zyuryukin

Saratov Branch of Radiotechnics and Electronics Institute RAS,
38, ul. Zelyonaya, 410019 Saratov, RUSSIA
E-mail: kazakov@sfire.saratov.su

Deposition of the piezoelectric oxide zinc thin films for acoustoelectronics is most simply realized in the magnetron ion-plasma reactors on direct current. In this case the planar constructions of the magnetron systems are used when ring zone of the tangential magnetic field is made over the metal target, prepared from pure zinc in form the plate. This target is cathode of gas-discharge gap and it is bombarded by the positive ions of neutral gas, usually argon, and oxygen, which are main gas components at low pressure (about 10 -3 mm of mercury). The established opinion is that there is the emission only of neutral atoms, negative ions and electrons from the target. This fact together with ionization process defines the existence of self-supporting gas discharge. The emission leads to the formation of ring erosive zone coinciding with ring zone of tangential magnetic field on the target surface. Outgoing from target particles pass through discharge gap and reach the substratum, which disposes on the some distance from the ring anode with its average diameter more then maximal diameter of erosive zone. Depositing on the substratum particles are oxidized on it and cause the growth of thin piezoelectric films at definite temperature of substratum.

In a result of the long work the authors exposed some other physical picture of this process. Special structure investigations of the deposited piezoelectric thin films were developed in condition of big area of the metal-coated glass substratum. It was marked that the growth of the oxide zinc thin film happens in the form of ring zones being coaxial with the erosive zone on the target. The central spot is transparent as a rule and it is the zone of longitudinal piezoelectric effect. The spot is surrounded by the ring of turbidity which is the zone without piezoelectric effect. Next here is the transparent ring and it is the piezoelectric zone of the thin film again. In turn this ring is surrounded by the ring of turbidity and so on. Authors observed more than five pairs of these rings. Testing by vibrant electromechanical probe showed that there is sequential increase from zero to 90o of the inclination angle of the texture axis to the substratum normal in the film piezoactive zones as far as observed point removes from center. These data permit to suppose that the growth of the piezoelectric film on substratum is stipulated by falling on it even "ready" oxide zinc molecules and their formation take place on the target surface. Moreover the piezoactive structure rings on substratum are the result of the original interference of molecular streams moving from the erosion zone to that or other substratum point.

This work is supported by Russian Foundation of Basic Research, grant 01-02-16317a.