The Influence of Obtained Conditions for Fundamental Absorption Edge in Y_2O_3 Thin Films

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Thin films Y_2O_3 with thickness 0.3–1.5 μm obtained by the method of discrete evaporation and RF-sputtering in this work have been investigated. X-ray diffraction data shoved the polycrystalline structure with predominant orientation in plain (222) and (440).

As a result of our studies, we established that regardless of the sputtering atmosphere and the heat treatment atmosphere, the absorption coefficient $\alpha(h\nu)$ for the thin films in the fundamental absorption edge region is described by a power-law dependence

$$\alpha(h\nu) = \frac{A(h\nu - E_g)^{1/2}}{h\nu}, \qquad (1)$$

from which we can determine the bandgap width E_g. Such behavior of the absorption edge is typical for allowed direct photon-assisted transitions.

Table 1

Energetic prameters in equation (1) and consolidated effective mass of free charge carriers in Y_2O_3

Films	E_g, eV	A, sm^{-1}eV$^{-1/2}$	μ
I	5.90	2.96×10^5	0.335m
II	5.84	2.83×10^5	0.322m
III	5.77	2.65×10^5	0.308m
IV	5.65	2.23×10^5	0.388m

It was ascertained that the optical band gap Eg increases from 5.65 eV for Y_2O_3 films, obtained by methods of discrete evaporation (IV), to 5.77 eV for films, obtained by ion-plasmous sputtering in atmosphere of argon (III), to 5.84 eV for films, obtained by ion-plasmous sputtering in atmosphere of 50% argon and 50% oxygen (III) and to to 5.90 eV for films, obtained by ion-plasmous sputtering in oxygen atmosphere(I). Consolidated effective mass of free charge carriers in Y_2O_3 films was estimated. It was found that the concentration of charge carriers in Y_2O_3 films obtained by ion-plasmous sputtering at addition in argon atmosphere 50 % of oxygen is $N\approx1.34\times10^{17}$ cm^{-3} and after sputtering in 100 % of oxygen $N\approx1.38\times10^{18}$ cm^{-3}, which is typical for degenerated semiconductors. It was shown that the shift of fundamental absorption edge in Y_2O_3 thin films after addition in sputtering atmosphere of oxygen is caused by Burstein-Moss effect.