Nanooptics and nanophotonics

Large nonlinear optical properties of iron oxide thin films synthesized by reactive pulsed laser deposition

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The third order optical nonlinear susceptibility in the thin films of Fe_2O_3 is studied. The Fe_2O_3 thin films were synthesized by means of reactive pulsed laser deposition on SiO_2 substrates at 293 K and 800 K and pressure in a chamber 0,1, 0,5 and 1Pa. XRD shows that the films at cold deposition have amorphous structure meanwhile at hot deposition the films have polycrystalline structure.

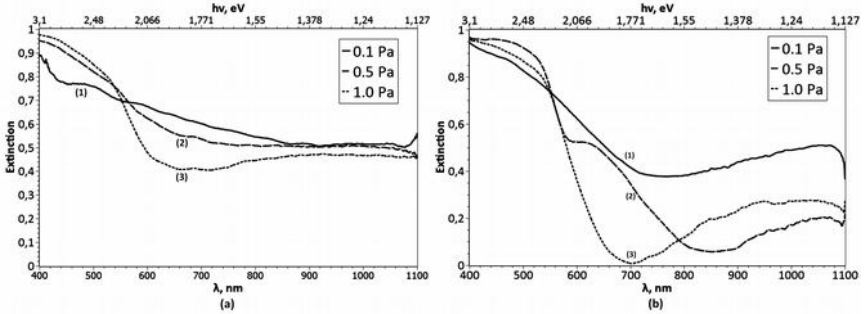

Fig.1 (a) – extiction spectra of the amorfous films; **(b)** – extinction spectra of the polycrystalline films, which are synthesized at different oxygen pressure in the reactor: 0.1, 0.5 and 1.0 Pa

Extinction curves (Fig.1) show a shoulder at 529-600nm especially for the films deposited at 1.0 Pa which is the evidence of the $E_g \sim 2.2$ eV band gap presence (i.e. pseudo band gap in amorphous films). The value is almost the same as that in α-Fe_2O_3 [1]. Nonlinear susceptibility coefficient $\chi^{(3)}$, nonlinear refraction coefficient n_2 and nonlinear absorption coefficient β are measured for all samples at λ=1064nm and 532nm, (pulse duration τ_p=20ns) as well as at λ=800nm (τ_p=180fs). The data obtained for the different samples and wavelengths are in the range of $1.1\times10^{-7} \div 5.6\times10^{-4}$ esu. The maximum values of the Re $\chi^{(3)}$ are obtained for the amorphous samples at different oxygen pressure 0.5, 0.1 and 1 Pa and are 5.6×10^{-4}, 3.9×10^{-4} and 1.1×10^{-4} esu, respectively, for λ=1064nm excitation. The obtained results show that the material in question is prospective for the contemporary optoelectronics.

1. *S.S. Shinde, R.A. Bansode, C.H. Bhosale, and K.Y. Rajpure*: J. Semicond. 32, 013001 (2011).