Photorefractivity of indium oxide (InOₓ) using 193nm excimer laser radiation

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Indium Oxide (InOₓ) is being extensively used in microelectronic technology due to its important optical and electrical properties. Dynamic photorefractive behaviour of InOₓ exposed in the near UV region (325nm) at low intensity (~0.25W/cm²) has been demonstrated for films grown by DC magnetron sputtering [1] and Pulsed Laser Deposition [2]. In this paper the investigation of photorefractive effects of InOₓ in the deep UV region (193 nm) is presented. Polycrystalline InOₓ films were grown by DC magnetron sputtering, in O₂/Ar atmosphere, in a variety of thicknesses (0.5 μm- 4 μm). Photorefractive gratings were recorded in InOₓ films using a typical “in contact” phase mask configuration. An ArF excimer laser delivering 20 nsec pulses (FWHM) @ 193 nm was used for the phase mask illumination at an intensity of 0.9MW/cm² (energy density of 1.8x10⁻² J/cm²). Single and multi-pulse exposures were performed at low repetition rates. The recorded gratings were detected using a He-Ne laser at normal incidence and the refractive index changes produced were calculated from the measured diffraction efficiency. Refractive index changes up to 5.0x10⁻³ were observed. The stability of the photinduced index changes were investigated by monitoring the diffraction efficiency dynamics. The monitored diffraction efficiency decays reaching a plateau approximately 50% of its initial peak.

The photorefractivity of InOₓ using high power c.w. 244nm and pulsed 248nm laser radiation has also been investigated. Possible applications of InOₓ films include high refractive index waveguide overlays for sensor and telecommunication purposes.

Phase mask arrangement for grating recording

![Phase mask diagram]

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Abstract

Photorefractive gratings structures have been formed in Indium Oxide films using a 193nm excimer laser illuminating a phase mask. Refractive index changes up to $5 \times 10^{-3}$ were measured and the dynamic behaviour of the effect studied.