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Ga_2O_3 Thin Films for Integrated Photonics through Doping and Ion Implantation

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Gallium oxide (Ga_2O_3) is a wide-bandgap semiconductor that has attracted significant attention for optoelectronic and photonic applications. Recent studies suggest that it is possible to tune both its bandgap and refraction index with aluminum incorporation, making it an even more versatile material platform for next-generation broadband integrated photonic devices. This thesis aims to make use of this tunability to enable local refractive index engineering for photonic applications, particularly as optical waveguides, via irradiation and ion implantation. This involves the fabrication, modification and optical characterization of Ga_2O_3 thin films to achieve better control over their optical properties.

The thin films are fabricated using radio-frequency magnetron sputtering (RFMS) under varied deposition conditions with controlled aluminum incorporation. Post-deposition annealing is used to modify their optical properties, while ion implantation and irradiation will be investigated as techniques for local modification of the refractive index. Characterization methods, including ellipsometry, optical absorption spectroscopy, Rutherford backscattering spectrometry (RBS), X-ray diffraction (XRD) and scanning electron microscopy (SEM) are used to evaluate the film's optical response, composition and structure. Preliminary experimental results confirm the modification of the films'optical properties through doping and different deposition conditions, with changes observed in refractive index and bandgap energy.

Field of Research/Work

Condensed Matter and Materials

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