Electron Cyclotron Resonance Plasma Enhanced Chemical Vapour Deposition (ECR-PECVD): A Versatile Tool in the Fabrication of Optoelectronic Devices

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Thin silicon oxynitride films (SiO_xN_y), deposited by electron cyclotron resonance plasma enhanced chemical vapor deposition (ECR-PECVD), are finding widespread applications in today's microelectronics and optolectronics industries. Among the most important applications pursued in our laboratories are their uses as anti-reflection and highly reflective optical coatings, as facet coatings in the development of compact diode laser sources for the generation of ultra-short light pulses, and as critical components for band gap shifting in 1.55 μm quantum well laser structures. Very recently, we demonstrated the applicability of ECR-PECVD in the fabrication of Erbium doped waveguide amplifiers, using an Er chelate as the dopant source and SiO_xN_y films as the host glass.

In this talk, we will discuss a number of issues relevant to the fabrication and characterization of SiO_xN_y films that meet the stringent requirements of the above applications. We will describe the operation of our ECR-PECVD system and the calibration steps necessary to produce reliably high quality films and will also discuss the respective strengths of several complementary techniques used in the characterization of the thin films. These include ellipsometry, a powerful method to determine the optical characteristics, nuclear reaction analysis (NRA), used to accurately quantify simultaneously the oxygen and nitrogen areal densities, elastic recoil detection (ERD), used to determine the hydrogen concentration in the films, as well as Fourier transform infrared (FTIR) and X-ray photoelectron spectroscopies (XPS), which provide information about the inter-atomic bonding characteristics.