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Τίτλος

«Photoelectrochemical etching for fabrication of GaN based air-gap DBR membranes»

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Η παρουσίαση θα διεξαχθεί με τηλεδιάσκεψη στον παραπάνω σύνδεσμο, σύμφωνα με α) την παρ. 1 του άρθρ.12 της από 11.3.2020 Πράξης Νομοθετικού Περιεχομένου (Α'55), και τις οδηγίες εφαρμογής Α Δ1α/Γποικ.28237/5.5.2020 Κ.Υ.Α (Β'1699), ΑΔΑ: ΨΠ7046ΜΤΛΗ-43Φ.

Περίληψη:

The last decades there has been intense interest on Galium Nitride (GaN) as a semiconductor material of direct energy gap, which belongs to III semiconductor groups, due to the enhanced optical properties that it can offer.

The most recent use of this material lies to the fabrication of Distributed Bragg Reflectors, which are periodic structures formed from alternating layers of materials. These semiconductor layers present an optical path length that equals $\lambda = \lambda0/4$, where λ0 is the Bragg wavelength and their reflectivity is influenced by the number of periods and the different refractive indexes. The main asset of these hetero-structures is that within a range of frequencies and with minimum amount of loses, they are able to attain almost total reflection.

Due to the elevated performance that they demonstrate, devices such as vertical-cavity surface emitting layers (VCSELs) can be benefited. However, several challenges have arisen caused by the restriction on the index contrast that these alloys structures provide. To overcome these challenges for the approach of a high reflectivity value, a considerable number of periods must be used, however, despite the lattice match, the constraintment on the index contrast remains a challenge.

In this thesis, theoretical DBRs models were created and by taking advantage of the electrochemical properties and the selective nature of Photo-electrochemical Etching (PEC) process, we proceed to the fabrication of Air-Gap, GaN based DBRs with four alternating periods of GaN and Air, for the obtainment of a wider contrast in refractive index to achieve higher reflectivity. PEC etching is a process that involves electrochemical reactions of semiconductors caused by photo-stimulation when they come in contact with electrolytes (in our case KOH solution). This process presents useful properties such as light-intensity dependence or band gap selectivity and is characterized by minimal "damage" on the surface of the material, in room temperature conditions, and faster etching speed compared to the dry plasma etching technique, which can cause large unevenness to the sidewalls of the membranes.

Finally, considering the state of the art of this procedure and by taking advantage the fundamental principles of modern optics, a set up capable of conducting micro-photo-electrochemical etching, for better experimental results, was created.