XXX Aniversario

Sociedad Mexicana de Ciencia de Superficies y Vacío

Instituto Nacional de Astrofísica, Óptica y Electrónica

La Sociedad Mexicana de Ciencia de Superficies y Vacío

y el

Instituto Nacional de Astrofísica, Óptica y Electrónica

en el marco de los festejos por su XXX aniversario

invitan al

Curso corto:

Producción y Caracterización de Materiales Optoelectrónicos

con duración de 20 horas en cuatro módulos.

Modulo I: "Transparent conducting metal oxide semiconductor films: Technology, characterization, and Applications in optoelectronic devices "

Dr. Alexander Malik
Microelectrónica
INAOE

During the last decade, transparent conducting oxide (TCO) films have been widely used in a variety of applications, namely, as gas sensors, heat reflectors, protective coatings, as light transparent electrodes in solar cells, laser-damage resistant coatings in high power laser technology, antistatic surface layers, surface layers in electroluminescent applications, an active electrode in surface-barrier photodiodes *et.al*.

A number of materials such as indium oxide, tin oxide, zinc oxide and cadmium stannate can be used for different scientific and technical applications.

The basic properties of these films that are most important for practical applications are their electrical and optical properties, which depend strongly on microstructure of TCO films.

During a short course, the growth techniques and their limitations, electrical and optical properties of thin films, and applications of both commonly used materials, such as tin oxide, indium oxide, indium tin oxide, cadmium stannate and zinc oxide, and a new p-type TCO films discovered recently, will be discussed.

This course should be useful for practicing engineers, applied scientists, and graduate students who may want to know more about TCO films.

This module short course is divided into five chapters.

Chapter 1 presents a brief introduction to the subject of transparent semiconducting coatings. The basic properties of the materials most commonly used for these coatings are also discussed.

Chapter 2, in general, deals with different growth techniques employed for the preparation of these coatings with an accent on the spray deposition technique. Chapter 3 presents the discussion of structural, electrical, and optical properties of TCO coatings fabricated by spray pyrolysis technique with reference to optoelectronic applications of these films.

Chapter 4 is a set of examples to illustrate successful original applications of TCO film for silicon solar cells, photodetectors on different semiconductor compounds, and room-temperature light-emitting silicon-monocrystalline diodes.

Chapter 5 presents the recent results of Japanese scientists in the field of p-type TCO film developing. The fabrication technology and physical characteristic of new p-type TCO films is discussed. As an application of these films, transparent diodes with rectifying behavior and UV room-temperature-operated LEDs are reviewed.

Modulo II: "Epitaxia por haces moleculares, fundamentos y aplicaciones en la optoelectrónica"

Dr. Máximo López López
Departamento de Física
Cinvestav-IPN

La técnica de crecimiento por epitaxia de haces moleculares (MBE, del inglés molecular beam epitaxy), desde sus inicios a principios de los años '70, se consideró una técnica muy sofisticada limitada a los laboratorios científicos de investigación básica y que difícilmente podría tener aplicaciones industriales. Sin embargo, hoy en día MBE es la técnica preferida para la fabricación de una gran variedad de dispositivos electrónicos y optoelectrónicos usados en sistemas de comunicación inalámbrica, comunicación vía satélite, redes de fibra óptica de alta velocidad, computadoras, DVD's, etc.

En este módulo se presentará la técnica de MBE abarcando desde sus grandes aportaciones a la ciencia básica, hasta sus aplicaciones actuales para la fabricación de una variedad de dispositivos electrónicos y optoelectrónicos.

Los temas a cubrir son los siguientes:

1. Descripción de un sistema de MBE.
2. Técnicas de análisis usadas en MBE.
3. Procesos físicos y químicos durante el crecimiento de diferentes tipos de compuestos y aleaciones semiconductoras:
   III-V, II-VI y IV-IV.
4. Fabricación de estructuras cuánticas de baja dimensión:
   Pozos, Hilos y Puntos Cuánticos.
5. Producción de dispositivos:
   MESFETs , PHEMTs, HBTs, Láseres y Diodos Emisores de Luz.
6. Perspectivas.

Modulo III: "X ray scattering, basic principles and applications in the characterization of thin film structures."

Dr. Matej Jergel
Departamento de Física
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The elastic X-ray scattering produces variety of phenomena such as diffraction, reflection, diffuse scattering or standing waves which gave rise to numerous experimental techniques. Historically the first one is the diffraction analysis of bulky samples where routine procedures are available now. Later, the advent and progress in planar thin film technology stimulated the need for surface and near-surface sensitive X-ray techniques which eliminate the substrate signal. Thin films patterned on the nanometer scale represent the latest challenge. Such structures produce unique interference phenomena which are intensely studied nowadays and have direct output not only in structural analysis but also in new optical elements for X-UV region. The non-destructive character and simultaneous probing both the surface morphology and near-surface inner structure render the X-rays superior to competing surface sensitive techniques. This module will give a brief overview of the above-outlined progress starting from the basic principles of the elastic X-ray scattering and basic notions of X-ray crystallography. The practical examples will concentrate on the mono- and multilayer thin films for microelectronics and X-UV optics.

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Modulo IV: "Towards room-temperature silicon-monocrystalline LEDs: Physical aspects, designing and characterization".

Dr. Alexander Malik
Microelectrónica
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Silicon is the most important semiconductor material for the integrated circuit (IC) industry. However, its importance in optoelectronics is not as prominent due to its indirect band-gap characteristics. For decades, many efforts have been devoted to making silicon useful for optics or optoelectronics. These efforts include fabricating optical waveguides or micro-optics on Si, as well as converting silicon into light-emitting materials such as porous-silicon-based devices, nanocrystalline Si, Si^+-implanted SiO_2, and so on.

Recently, set of the experimental works of Taiwanese, Japanese, German, and English researches shown the possibility to fabricate room temperature light-emitting diodes (LEDs) with efficiency right up to 0.2-0.3% on the basis of the monocrystalline silicon. Such LEDs can emit the light at wavelength of ~ 1.16 μm (band-to-band transitions) and ~ 1.6 μm (D1-D4 dislocation bands). It introduces a new generation of LEDs and offers a unique industrial perspective towards the silicon full-integrated optoelectronics, including possible optical interconnect applications for ULSI circuits.

This module short course is a brief review of different directions towards room-temperature silicon-monocrystalline LEDs designing, as well as the presentation of original results obtained by lecturer.

The theoretical approaches for an efficient Si-LEDs developing, operation principles, fabrication as well as the different practical silicon-monocrystalline LEDs' designs will be discussed.

This module is directed to open new point of view on the possibility of monocrystalline silicon. The module matter can be useful for engineers and scientists working in the field of optoelectronics, as well as for graduate students to initiate their interest towards new future of silicon-based optoelectronics.

El curso corto se llevara a cabo en las instalaciones del Instituto Nacional de Astrofísica Optica y Electrónica de 9:00 a 14:00 y de 15:00 a 20:00 horas el jueves 21 y viernes 22 de junio de 2001.

Se dará **constancia con valor curricular** a los participantes que asistan a los cuatro módulos.

El costo del curso sera de 300.00 pesos, incluye el material del curso y recesos de cafe.

Se otorgaran becas a estudiantes miembros de la SMCSyV.

El contenido de los módulos puede consultarse en nuestra pagina en internet http://www.fis.cinvestav.mx/~smcsyv/ o abriendo el documento adjunto que se encuentra en formato PDF.

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