SUMMER LECTURE in 2016

Web-casting by Osaka University

Session A: From July 28th to August 5th except for July 31st, 2016

Place: Laboratory of Advance Research B 0110　総合研究棟 B0110（大阪大学から TV 中継）

Lecturer: Prof. Ulrike Woggon

Affiliation: Technical University of Berlin, Germany

Title: Optical Spectroscopy of Nanostructured Materials

Time: 12:45－14:19 (July 28－August 1), 9:00－10:34 (August 2－5)

ナノテクノロジー特別講義 I

Abstract:

-Fundamentals of nonlinear optics and ultrafast spectroscopy

-Concepts of light-matter interaction

-Application to bulk semiconductors, semiconductor nanostructures, carbon nanotubes, metals and metamaterials

-Coherent photonics in semiconductor devices

古典、半古典から量子的描像まで、光と物質の相互作用の基礎知識について講義します。非線形光学や超高速スペクトロスコピーを紹介し、半導体量子ドット、カーボンナノチューブやコロイド微粒子に適用します。

Lecturer : Dr. Tristan Cren

Affiliation : CNRS/Institute for NanoSciences of Paris, UPMC (Uiversity of Pris VI), France

Title: STM and STS measurements of emerging electronic phenomena in new correlated materials and nanostructures

Time: 14:30－16:04 (July 28－August 1), 10:45－12:19 (August 2－5)

ナノテクノロジー特別講義 II

Abstract:

-Principles of scanning tunneling microscopy (STM) and scanning tunneling spectroscopy (STS)

-Basic material science of strongly correlated electron systems

-STM and STS measurements of electronic phenomena in correlated materials and nanostructures

走査型トンネル顕微鏡(STM)と走査型トンネルスペクトロスコピー(STS)の原理と、材料科学への応用について解説します。

SUMMER LECTURE in 2016

Web-casting by University of Tsukuba

Session A: July 28th to August 5th except for July 31st, 2016

Place: Laboratory of Advance Research B 0110　総合研究棟 B0110（筑波大学から TV 中継）

Lecturer: Prof. Etienne GHEERAERT

(Institute Néel, CNRS, Univ. Grenoble-Alpes, and Univ. Tsukuba)

Title: Solid-State Diffusion

Time: 9:00ー10:34 (July 28ーAugust 1), 14:30ー16:04 (August 2ー5)

ナノテクノロジー特別講義Ⅲ

Outline: The objective of the course is to modelize the atomic diffusion that occurs in solid at high temperature during small duration, or low temperature during extended periods. This is particularly important for microelectronics devices, but also photovoltaic cells and LED for solid-state light sources. Main processes include solid-state diffusion, ion implantation, defects formation and recovery. The phenomena are illustrated in the case of silicon, mainly, and of “alternative” semiconductors (SiC, GaN, diamond…).

- Introduction: Historical milestones, macroscopic manifestation of atomic diffusion.
- Diffusion equations: Fick laws, solutions of diffusion equation, random walk in 2D and 3D, Einstein-Smoluchowski equation.
- Diffusion in solids : Impurities and defects, elements of thermodynamics, formation and migration of defects, diffusion mechanisms, enhanced diffusion, inter-diffusion, Deal and Grove model.
- Ion-matter interaction: Physics of ion stopping, nuclear and electronic stopping, implantation profile, Implantation profile and annealing, Transient Enhanced Diffusion.

概要：固体中の原子の拡散について講義します。拡散のモデルについて議論し、集積デバイス、太陽電池、発光素子などの種々の電子デバイスの作製・プロセスに現れる固体中の原子拡散、イオン打ち込み、欠陥の生成と回復などの現象を扱います。主としてシリコン中の拡散現象を取り上げますが、SiC, GaN, ダイヤモンドなどのワイドギャップ半導体における例も紹介します。

Lecturer: Prof. Henri MARIETTE

(Institute Néel, CNRS, Univ. Grenoble-Alpes, and Univ. Tsukuba)

Title: Elaboration of Semiconductor Nanostructures

Time: 10:45－12:19 (July 28－August 1), 12:45－14:9 (August 2－5)

ナノテクノロジー特別講義Ⅳ

概要：半導体ナノ構造の種々の作製法およびその物性について講義します。種々の半導体物質の紹介から始め、エピタキシャル成長における核形成、歪の緩和、表面再構成など、薄膜成長の基本的事柄を取り上げた後、低次元ナノ構造の種々の作成手法を紹介します。またナノ構造の特徴的な物性についても講義します。

Lecture on « Elaboration of Semiconductor Nanostructures »

This lecture will present the various growth methods, and especially all the epitaxial technics, to achieve and control semiconductors nanostructures having specific physical properties.

Outline of the lecture

1. **Introduction to the various semiconductor materials.**
   - Si, Ge, III-V, II-VI
   - direct / indirect gaps
   - binaries versus alloys
2. **Nucleation and growth**
   - basic phenomena controlling the formation of epilayers
   - plastic relaxation and elastic relaxation in the case of strained hetero-epitaxy
   - 2D, 1D, OD epitaxial growth
3. **Surface physics**
   - Blende-zinc and diamant cristallographic structures
   - Surface reconstructions
   - Atomic layer epitaxy
   - Growth on vicinal surfaces
   - Artificial nanostructures
4. **Presentation of various growth methods for thin layers**
   - Evaporation under vacuum
   - Cathodic pulverisation
   - Liquid phase epitaxy
   - Vapor phase epitaxy (CVD, MOCVD)
   - Molecular Beam Epitaxy (MBE)
   - Comparison (advantages,drawbacks
5. **Application to epitaxy of low dimensional structures**
   - bi-dimensional structures: quantum wells.
   - uni-dimensional structures: quantum wires.
   - zero-dimensional structures : quantum dots.

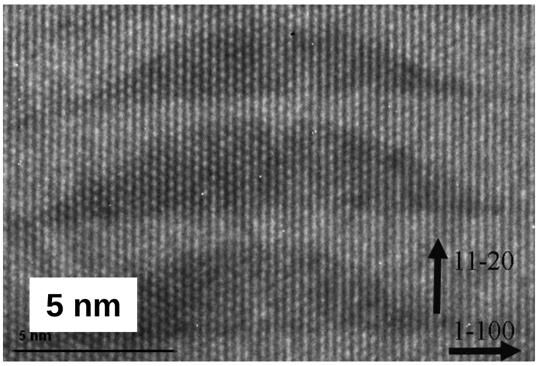

Image of high resolution transmission electron microscopy for GaN/AlN quantum dots obtained by molecular beam epitaxy (Catherine Bougerol).

Session B: August 29th to September 9th except for September 3rd and 4th, 2016

Place: Laboratory of Advance Research B 0611　総合研究棟 B0611（筑波大学から TV 中継）

Lecturer: Prof. Christophe VALLEE

(LTM- CEA/LETI MINATEC, Univ. Grenoble-Alpes, and Univ. Tsukuba)

Title: Thin films and advanced plasma processes (PEALD and ALE) for Microelectronics

Time: 10:10-11:25

ナノテクノロジー特別講義Ｖ

Outline: Progress and innovation for information and communication society in the last decades were obtained thanks to the miniaturization of semiconductor devices in parallel with the introduction of new materials and technologies. Moreover, introduction of new materials always leads to new challenges in material processing. Indeed, the CMOS scaling came with a need to introduce new gate dielectric (HfO_2), new approach (gate first *vs* gate last) but also new processes (dual frequency plasma sources for the etching and Atomic Layer Deposition (ALD) for the deposition of HfO_2).

Some of the recent and future challenges for microelectronics industry will be addressed with this course focused on new materials (mainly dielectrics) and new processes currently developed in clean room such as Plasma Enhanced Atomic layer Deposition (PEALD) and Atomic Layer Etching.

概要：現在のマイクロエレクトロニクス産業の進展を支える新しい物質およびプロセス法の開発について講義します。特に新しい誘電体薄膜の開発、ならびにプラズマを利用した新しいプロセス(プラズマ励起原子層堆積法および原子層エッチング)に焦点を当て、詳しく紹介します。