大阪大学 OSAKA UNIVERSITY

rijksuniversiteit groningen

INSD NanoScience Video Exchange Lectures (2020, Groningen-Osaka)

These lectures are held as a part of **"Fundamental and functional properties of nanomaterials"** in top Master NanoScience in Groningen and as **"International Exchange Lectures on Nanoscience and Nanotechnology A"** in INSD Nano Program in Osaka. The program is also shared by University of Science-Malaysia, King Mongkut's Institute of Technology Ladkrabang-Thailand, and Institute for Materials Science VAST-Vietnam.

The lectures except for October 9th start on the following Fridays at 9:00 in the morning (Groningen time), that is, at 16:00 or 17:00 in the afternoon (Osaka time).
[NOTE The Netherlands switches from summer time (day light saving time) to winter time on the night of November 1st (Sun) 01:00 (UTC) 2020.]

Lecture 0

Friday, 9 Oct. 2020
Osaka time: 16:00-18:15 (no exchange lecture from Groningen)

Prof. Tadashi Itoh, Institute for NanoScience Design (speaks 16:00-18:15 (O))
(Field: solid state physics, semiconductor nanocrystal (quantum dot), optical properties)
Title: Introduction, Photophysics of quantum dots.
(Together with video address and Nobel-Prize lecture given by Prof. Benard L. Feringa)
Abstract: Electronic excited states (excitons) in semiconductor nanocrystals show peculiar quantum size effects which exhibit various kinds of characteristic optical properties; blue shift and splitting of the exciton energy states, rapid radiative decay, ultrahigh speed giant optical nonlinearity, highly efficient lasing, etc.

Lecture 1

Friday, 16 Oct. 2020
Osaka time: 16:00-18:15
Groningen time: 9:00-11:00

Chair: Prof. Tadashi Itoh
Prof. Akira Harada, Graduate School of Science (16:00-16:55 (O) / 9:00-9:55(G))
(Field: macromolecules, self-assembly, self-healing)
Title: Supramolecular materials
Abstract: Macromolecular recognition is classified as main-chain recognition and side chain recognition. Main-chain recognition is involved in the formation of polyrotaxanes in which some cyclic molecules are threaded onto a polymer chain. We have studied on the relative movement of cyclic parts and a linear chain. We can control the rates and the direction of the cyclic parts on a polymer chain. In addition, we have achieved macroscopic self-assembly and self-healing systems through side-chain recognition.

Chair: Prof. Thomas Jansen
Prof. Loredana Protesescu (10:00-10:55 (G) / 18:00-18:55 (O))

(Field: nanomaterials)

Title: Functional inorganic nanomaterials

Abstract: As a special class of materials, inorganic nanomaterials consist of particles of metals, metal oxides, metal chalcogenides (metal sulfides, selenides, or tellurides) or halide perovskites with at least one dimension in the 1- to 100-nanometer (10−9 m) range. These nanomaterials are highly interesting because they exhibit properties that bridge the gap between bulk and molecular structures. Unlike their bulk counterparts, nanomaterials exhibit tunable size- and shape-dependent optical, electronic, and magnetic properties. Because of these unique properties, nanomaterials are being explored to address key global challenges in areas such as energy conversion, catalysis, medicine, sensing, and environmental remediation.

Lecture 2

Friday, 23 Oct. 2020

Osaka time: 16:00-18:15
Groningen time: 9:00-11:00

Chair: Prof. Tadashi Itoh

Prof. Syoji Ito, Graduate School of Engineering Science (16:00-16:55 (O)/ 9:00-9:55 (G))
(Field: laser manipulation, single-molecule detection)

Title: Single-molecule fluorescence detection: methods and applications

Abstract: The lecture starts with the history of single-molecule fluorescence detection (SMFD) and the introduction of typical methods of SMFD: confocal and wide-field microscopies. Then several important applications of SMFD are shown, e.g. fluorescence correlation spectroscopy, single-molecule tracking, and super-resolved fluorescence imaging.

Chair: Prof. Thomas Jansen

Prof. Remco Havenith (speaks 10:00-10:55 (G) / 17:00-17:55 (O))
(Field: Theoretical Chemistry)

Title: Calculation of molecular properties

Abstract: I shall talk about the calculation of molecular properties. Techniques for calculating properties will be discussed and examples of applications will be shown. Main topics that will be discussed is the calculation of magnetically induced current densities and NMR chemical shifts.

Lecture 3

Friday, 6 Nov. 2020

Osaka time: 17:00-19:15
Groningen time: 9:00-11:00 (in winter time)

Chair: Prof. Tadashi Itoh

Prof. Hidekazu Tanaka, Institute of Scientific and Industrial Research
(17:00-17:55 (O) /9:00-9:55(G))
(Field: electronic/magnetic/optical properties of oxide thin films and their nanostructures)

Title: Basics and Applications of Electronic Phase Change Oxides

Abstract: Phase change materials enable rapid switching between different structural phases, resulting electric properties switching. Some classes of materials are interesting on switching between different electronic/spin phases itself, such as Mott insulator- metal transition, and their

electronic phase change would produce new classes of devices. This part of the lecture will focus on electronic phase change phenomena on transition metal oxides.
Topics will be included, ・Physics and material science on structural and metal/insulator transition of VO_2 as a prototype material, ・Brief review of phase change phenomena on transition metal oxides (vanadate, manganite, nickelate, ferrite, ruthenate, etc.), ・External field induced electronic phase change phenomena, ・Switching/Memristive /Biology-inspired /Photonic devices based on electronic phase change materials.

Chair: Prof. Thomas Jansen
Prof. Thomas la Cour Jansen (speaks 10:00-10:55 (G) / 17:00-17:55 (O))
(Field: computational spectroscopy and optical properties)
Title: Quantum design of nanomaterials.
Abstract: Quantum mechanics is determining the properties of materials on the atomic scale. Macroscopic systems on the other hand can be described well with classical dynamics. In this talk quantum mechanical effects on the nanometer length scale will be discussed. First, the delocalization of electronic wave functions over nanoscale super molecular structures will be discussed. Secondly, the effect of quantum interference between such wave functions will be discussed and how this phenomenon can be used to design materials with desirable properties and suppressed (or enhanced) charge recombination in heterojunction materials and exciton-exciton annihilation in light-harvesting systems.

Lecture 4

Friday, 13 Nov. 2020
Osaka time: 17:00-19:15
Groningen time: 9:00-11:00 (in winter time)

Chair: Prof. Tadashi Itoh
Prof.Yasufumi Fujiwara, Graduate School of Engineering (17:00-17:55 (O) /9:00-9:55(G))
(Field: rare-earth-doped semiconductors, OMVPE growth, LED, luminescence, energy transfer)
Title: Fundamentals of light-emitting diode with rare-earth-doped semiconductors
Abstract: After the groundbreaking invention of blue and green light-emitting diodes (LEDs) employing nitride semiconductors ($In_xGa_{1-x}N$/GaN), there has been a strong demand to develop red LEDs using nitride semiconductors. We have focused on europium (Eu) ions that have been widely used as an activator for red phosphor, and have succeeded in growing Eu-doped GaN (GaN:Eu) layers with high crystalline quality by atomically-controlled organometallic vapor phase epitaxy (OMVPE), as well as developing the world's first red LED that operates at room temperature using GaN:Eu as the active layer. This lecture will cover current status of conventional GaN-based LEDs and the GaN:Eu red LED, present understanding of Eu luminescent sites formed in GaN and future strategies for the improved light output of the LEDs.

Chair: Prof. Thomas Jansen
Prof. Jan Anton Koster (10:00-10:55 (G) / 17:00-17:55 (O))
(Field: Photophysics and optoelectronics, semiconductors and devices, thermoelectrics)
Title: Organic semiconductors for thermoelectrics
Abstract: In this lecture, I will introduce organic semiconducting materials and will briefly review their charge transport properties. Next, I will emphasize their promise for thermoelectric applications.