



GLOBAL INITIATIVE OF ACADEMIC NETWORKS  
(GIAN)



## Course on

# One-dimensional metal-oxide nanostructures: Recent developments in synthesis, characteristics and applications

January 28-February 8, 2019

Discipline of Metallurgy Engineering and Materials Science,  
Indian Institute of Technology Indore- 453552. INDIA.

### Overview:

The objective of this course is to provide an introduction to, and overview of, the physics of the 1D metal-oxide nanostructures. It should be suitable for undergraduate physicists and engineers who are interested in this application of semiconductor physics, and to non-specialist graduates and others who require a background in the physical principles of the 1D metal-oxide nanostructures. The focus is on the basic semiconductor physics relevant to the 1D metal-oxide nanostructures, and how these relate to the design and function of practical devices.

|                 |   |
|-----------------|---|
| Modules         | A: Lectures : January 28-February 8, 2019<br>B: Tutorials/labs : January 28-February 8, 2019  |
| Target Audience | Executives, engineers and researchers from manufacturing, service and government organizations including R & D laboratories.<br>• Student students at all levels (B. Tech./M. Sc./M. Tech./Ph. D) or Faculty from reputed academic institutions and technical institutions.   |
| Fees            | Participants from abroad: US \$500:00<br>Academic Institutions: INR 4,000<br>Industry/Research Organizations: INR 10,000<br><br>The above fee include all instructional materials, computer use for tutorials and assignments, laboratory equipment usage charges, 24 hr free internet facility. Working lunch will be served. The participants will be provided with accommodation on payment basis. |
| Accommodation   | You may request to <a href="mailto:hostel@iiti.ac.in">hostel@iiti.ac.in</a> for checking availability   |
| Registration    | Kindly register for course at <a href="http://gian.iiti.ac.in/register.php">http://gian.iiti.ac.in/register.php</a> and send the registered details on <a href="mailto:drpmshirage@gmail.com">drpmshirage@gmail.com</a>   |

### The Faculty



**Dr. Yuan-Ron Ma** is Professor and Head *Department of Physics* National Dong Hwa University & Dean, Office of International Affairs, National Dong Hwa University, Taiwan. He conducts research on synthesis, characterization and applications of zero-dimensional (0D) nanoparticles, one-dimensional (1D) nanostructures, and discontinuous two-dimensional (2D) thin-films of metals and metal-oxides. His recent interests include structural, electronic, electrical, electrochromic, optical and magnetic measurements for their unique properties and potential applications, such as, nanoelectronics, smart windows, light-emitting diodes (LEDs) and laser diodes (LDs), spintronics devices. He has edited about 60 manuscripts for *Scientific Reports*, and reviewed more than 250 papers for various SCI journals. His authoring SCI papers include *Physical Review Letter*, *Physical Review B*, *Crystal Growth and Design*, *Nanoscale*, *Nanotechnology*, *RSC Advances*, *Advanced Functional Materials*, *Physical Chemistry Chemical Physics*, *Journal of Materials Chemistry C*, *Scientific Reports*, and so on. The article published in *Advanced Functional Materials* (2012, 22, 3326-2270) has been cited 248 times. The sum of total citations is over 1,400, average citation per article is 15.32, and *h*-index is 22, respectively, for his citation performance. More details are available <http://nanosciencelab.blogspot.tw/>



**PARASHARAM M. SHIRAGE** is Associate professor in Metallurgy Engineering and Materials Science, Indian Insititue of Technoloyp Indore. His research interest includes next generation solar cells, gas and humidity sensors, energy storage ( battery and supercapcitors), bio-sensors, electrochemistry, thin film growth and applications, utilization of high pressure to synthesize novel materials, novel superconductors search, isotope effects, point contact spectroscopy, microwave studies,

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**DR. RUPESH S. DEVAN** is Assistant Professor in Metallurgy Engineering and Materials Science, Indian Institute of Technology Indore, India. His research interest included synthesis and characterization of metal-oxide nanostructures and polymers for engineering energy applications. He also concentrates on the synthesis of nano-hetero-architectures and core-shell nanostructures for fabrication of energy conversion/storage devices, displays, smart windows and resistive switching devices. More details are available at <https://rupesh76.wixsite.com/rupesh>

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**Tentative Lectures Schedule:**

**Course Structure**

| Day & Subject                       | Schedule          | Time          | Subject   |
|-------------------------------------|-------------------|---------------|---|
| Day1<br>2019.01.28<br>Introduction  | Lecture 1         | 10:00 ~ 11:00 | Recent developments in synthesis, characteristics and applications  |
|                                     | Lecture 2         | 11:15 ~ 12:15 |   |
|                                     | Break             | 12:15~ 13:00  |   |
|                                     | Lecture 3         | 13:00 ~ 14:00 |   |
| Day2<br>2019.01.29<br>Synthesis I   | Lecture 4         | 10:00 ~ 11:00 | Direct physical deposition techniques   |
|                                     | Lecture 5         | 11:15 ~ 12:15 | Physical vapor deposition (PVD) & Confinement growth  |
|                                     | Break             | 12:15~ 13:00  |   |
|                                     | <b>Tutorial 1</b> | 14:00 ~ 15:00 | Lithographic techniques (Tutorials)   |
| Day3<br>2019. 01.30<br>Synthesis II | Lecture 6         | 10:00 ~ 11:00 | Direct chemical deposition techniques   |
|                                     | Lecture 7         | 11:15 ~ 12:15 | Glancing angle deposition & Chemical vapor deposition (CVD)   |
|                                     | Break             | 12:15~ 13:00  |   |
|                                     | <b>Tutorial 2</b> | 14:00 ~ 15:00 | Hot-filament metal-oxide vapor deposition (HFMOVD) Sol-gel technique & Solvothermal technique (Tutorials) |

|   |                               |               |   |
|---|-------------------------------|---------------|---|
| Day4<br>2019.01.31<br>Growth<br>mechanism           | Lecture 8                     | 10:00 ~ 11:00 | Vapor-liquid-solid (VLS) growth mechanism                         |
|   | Lecture 9                     | 11:15 ~ 12:15 | Vapor-solid (VS) growth mechanism                                 |
|   | Break                         | 12:15~ 13:00  |   |
|   | <b>Tutorial 3</b>             | 14:00 ~ 15:00 | Solution-liquid-solid (SLS) growth mechanism<br>(Tutorials)       |
| Day4<br>2019.02.01<br>Anisotropic<br>crystalline I  | Lecture 10                    | 10:00 ~ 11:00 | Tungsten oxide,   |
|   | Lecture 11                    | 11:15 ~ 12:15 | Vanadium oxide,   |
|   | Break                         | 12:15~ 13:00  |   |
|   | <b>Tutorial 4</b>             | 14:00 ~ 15:00 | Nickel oxide, Tantalum oxide,<br>Molybdenum oxide,<br>(Tutorials) |
| Day5<br>2019.02.04<br>Anisotropic<br>crystalline II | Lecture 12                    | 10:00 ~ 11:00 | Titanium oxide  |
|   | Lecture 13                    | 11:15 ~ 12:15 | Niobium oxide   |
|   | Lecture 14                    | 12:15~ 13:15  | Zinc oxide  |
|   | Break                         | 13:15 ~ 14:15 |   |
| Day6<br>2019.02.05<br>Applications I                | Lecture 15                    | 10:00 ~ 11:00 | Bismuth oxide   |
|   | Lecture 16                    | 11:15 ~ 12:15 | Tin oxide   |
|   | Break                         | 12:15~ 13:00  |   |
|   | <b>Tutorial 5</b>             | 14:00 ~ 15:00 | Gas sensors<br>(Tutorials)  |
| Day7<br>2019.02.06<br>Applications II               | Lecture 17                    | 10:00 ~ 11:00 | Electrochromic devices  |
|   | Lecture 18                    | 11:15 ~ 12:15 | Light emitting diodes   |
|   | Lecture 19                    | 12:15~ 13:15  | Field emitters  |
|   | Break                         | 13:15 ~ 14:15 |   |
| Day8<br>2019.02.07<br>Applications III              | Lecture 20                    | 10:00 ~ 11:00 | Supercapacitors and Nanoelectronics                               |
|   | <b>Tutorials 6<br/>&amp;7</b> | 11:30- 12:30  | Supercapacitors and Nanogenerators                                |
|   |                               | 14:00 -16:00  | <b>Tutorials</b>  |
| Day 9<br>2019.02.08                                 | Examination                   | 10:00 ~ 12:00 | <b>Examination</b>  |

**Lectures: 20 hrs**

**Tutorials: 7 hrs**