



# CHEMISTRY AND PHYSICS OF SURFACES AND INTERFACES

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**PRE-REQUISITES** : Solid state chemistry

**INTENDED AUDIENCE** : Any Interested Learners

**INDUSTRIES APPLICABLE TO** : Companies that are working in the field of thin films.

### COURSE OUTLINE :

The course discusses about the general chemical and physical properties of surfaces of crystalline materials. Further the course will build up on the procedure of atomic level construction of surfaces from the bulk crystals and the nomenclature of different surfaces. We will try to understand the formation of different types of interfaces, like metal-metal, metal semiconductor, metal-molecule etc. and its significance in applications. The course will also cover the microscopic (scanning tunneling and atomic force microscopies) and spectroscopic (X-ray and UV photoelectron spectroscopy) understanding of surface and interfaces.

### ABOUT INSTRUCTOR :

Prof. Thiruvancheril G. Gopakumar completed his BSc from Mahatma Gandhi University in 1998. After completing his MSc in Physical Chemistry from School of Chemical Sciences, Mahatma Gandhi University in 2001, he moved to National Chemical Laboratory, Pune for a year.

### COURSE PLAN :

- Week 1:** General introduction to solid surfaces and interfaces of materials. Why surface is different or important? Applications of surface and interfaces in modern technology. Microscopic structure of different type of clean surfaces and the construction of surfaces from bulk crystals.
- Week 2:** 2D Bravais lattices, nomenclature of clean surfaces, reconstructions on surfaces, stepped and corrugated surfaces and its reactivity. Elementary processes of gas-surface interaction, adsorption (physical and chemical) and interface formation.
- Week 3:** Ultra-high vacuum (UHV) technology and its importance in surface science, adsorbates on surfaces, adsorbate lattice and the microscopic understanding, nomenclature of adsorbate layer on surfaces.
- Week 4:** Type of interfaces like metal-metal/semiconductor and metal-molecule interfaces. Self-assembly of molecules on surfaces. Methods for preparation of thin films (Physical and chemical methods).
- Week 5:** Scanning tunneling microscopy (STM) and atomic force microscopy (AFM). Operation and principle.
- Week 6:** Application of STM and AFM in characterizing microscopic structure of different surfaces and interfaces. Electronic structure of surfaces and interfaces using STM.
- Week 7:** X-ray photoelectron spectroscopy (XPS) and UV-Vis photoelectron spectroscopy (UPS), principle and significance as a surface analysis tool.
- Week 8:** Applications of UPS in understanding the electronic structure of surfaces and interfaces. Application of XPS: revealing the chemical properties of surface and interfaces.