Syllabus

Course Name: **Thin film deposition routes**

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Specific Goals for the Course

Thin films are fabricated by the deposition of individual atoms on a substrate. A thin film is defined as a low-dimensional material created by condensing, one-by-one, atomic/molecular/ionic species of matter. "Thin" is a relative term, but most deposition techniques allow layer thickness to be controlled within a few tens of nanometers, and some allow one layer of atoms to be deposited at a time. Thin films are a major area of scientific research because of its wide range of applications such as optics, electronics, biotechnology and the tool manufacturing industry. Examples include anti-reflection coatings, interconnects for printed circuit boards, bio-compatible films for surgical implants and ultra-hard films decreasing the wear rate of machinery parts. Deposition is a process, in which the surface layer is always submerged under a newly forming top layer resulting in a new surface. Deposition techniques fall into two broad categories, based on whether they are understood in terms of chemistry, or of physics.

By the end of the course students will be able to:

(i) Describe fundamental growth processes and material parameters in thin films and nanomaterial deposition such as growth rate, arrival rate ratio, surface energy, lattice parameters, density, stress, adhesion, stoichiometry, sticking coefficient, etc.;

(ii) Explain the effect of variable deposition parameters on the structural evolution;

(iii) Design depositions and syntheses of various materials;

(iv) Explain mechanism and kinetics in deposition of materials/nanomaterials;

(v) Select modern techniques of deposition for particular materials and conduct the deposition;

(vi) Apply the obtained knowledge to prepare different materials/nanomaterials at proper conditions;

(vii) Evaluate and select the most suitable processes of material syntheses to obtain desired material properties for functional coatings.

Topics of the Course

- **Introduction to Materials Science & Engineering**
- **Overview of Thin Films**
- **Thin Film Growth and Evolution**
- **Thin Film Deposition**
- **Physical deposition processes**
- **Chemical deposition processes**
- **Approaches for synthesis of nanomaterials**
- **Materials properties and measurement methods**

Text Book:

1. Seshan, K. ed., 2012. *Handbook of thin film deposition*. William Andrew.

2. Kafle, B.P., 2020. Spectrophotometry and its application in chemical analysis. *Chemical Analysis and Material Characterization by Spectrophotometry; Elsevier: New York, NY, USA*, pp.1-16.

3. Frey, H. and Khan, H.R. eds., 2015. *Handbook of thin film technology* (pp. 24-41). Berlin: Springer.

4. Callister Jr, W.D., 2007. *Materials science and engineering an introduction*.

5. Ohring, M., 2001. *Materials Science of Thin Films: Deposition and Structure*. Elsevier.

6. Wagendristel, A. and Wang, Y., 1994. *An introduction to physics and technology of thin films*. World scientific.