UNIVERSITÀ
DEGLI STUDI DI MILANO-BICOCCA

SYLLABUS DEL CORSO

Theory and modelling of epitaxy

2122-79R-M8

Title

Theory and modelling of epitaxy

Teacher(s)

Dr. Roberto Bergamaschini, Department of Materials Science

Language

English

Short description

Epitaxy, i.e. the ordered growth of one material on top of a crystalline substrate, is a key process in material science, ubiquitously used for the fabrication of high-quality films and hetero-structures of complex design. This course provides a general introduction to the physics of epitaxial growth, offering an overview of the key thermodynamic and kinetic factors driving the formation of thin-films rather than three-dimensional micro- or nano-structures during material deposition. While the focus of the course will be mostly on the theoretical aspects behind the growth, the content will be discussed by an applied perspective, constantly related to the experimental observations. The purpose is then two-fold: 1) to provide a comprehensive overview of current understanding and methods as a starting point for further, more specific, investigations of the growth dynamics; 2) to provide useful guide-lines for the interpretation and tuning of experiments.

After a general description of epitaxy, recalling its basic principles, experimental conditions and applications, the key thermodynamic aspects describing the crystal morphology and stability for both homoepitaxial and heteroepitaxial systems will be discussed. The analysis will then move from the macroscopic/continuum scale to the atomistic one, analysing the elementary mechanisms leading to the growth and highlighting the role of stepped surfaces in the evolution dynamics. Finally, the mechanisms of self-assembly of nanostructures and the peculiar techniques of droplet epitaxy and vapour-liquid-solid growth will be discussed.

1. Epitaxy: general concepts
2. Methods of epitaxy
3. Surface energy, equilibrium crystal shape and growth modes
4. Continuum models of morphological evolution
5. Nucleation theory and island growth
6. Plastic relaxation in epitaxy
7. Modeling growth at the atomic scale and step dynamics
8. Vapour-Liquid-Solid growth and advanced growth strategies

CFU / Hours

2 cfu / 16 ore

Teaching period

Winter 2022:

February 1, 3, 4, 8, 11, 14, 15, 18 (14.30-16.30).