PHS6317
NANO-ENGINEERING OF THIN FILMS

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Winter 2022

Bienvenue - Welcome

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PHS 6317 Nanoengineering of thin films

Course schedule – Winter 2022

14 January	Introduction – Scientific and technological challenges
21	Fabrication methods – Vacuum physics and vapor-phase techniques
28*	Fabrication methods – Thermal/Plasma spray technologies
4 February	Fabrication methods – Plasma processes
11*	Fabrication methods - Plasma-surfaces interactions and diagnostics
18***	Optics of thin films 1, optical characterization, *Miniquiz1 (5%)*
25**	Optics of thin films 2, design of optical filters

February 28 - March 4 - Winter/Spring break

11* March	*Presentations – Emerging fabrication techniques (30%)*
18***	Tribomechanical properties of films and coatings
25**	Electrochemical properties – corrosion and tribo-corrosion*(filter-20%)*
1 April	Passive functional films and coatings, *Miniquiz 2 (5%)*
8	Active functional films and coatings
15	Life cycle analysis and environmental impact
19***	*Presentations – Emerging applications of nanostructured films (40%)*

Evaluation

1. **Project 1:** Bibliographic research on an emerging fabrication technique of thin films - Report and presentation 30%

2. **Project 2:** Design of an optical filter - Report 20%

3. **Project 3:** Bibliographic research on a specific application of the nano- engineering of thin films - Report and presentation 40%

4. **Miniquiz** 1 and 2 (@ 5%) 10%

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Deadlines:

Project #1 – Fabrication technique:

Choice of the subject: **28 January**

Abstract and references: **11 February**

Report and presentation: **11 March**

Projet #2 – Design of an optical filter:

Choice of the subject: **25 February**

Report: **25 March**

Projet #3 – Application of nanostructred thin films:

Choice of the subject: **18 February**

Abstract and references: **18 March**

Report and presentation: **19 April**

Specific requirements

Project 1: Bibliographic research on an emerging thin film fabrication technique
Report and presentation (20% + 10% = 30%)

Deliverable: Report – max.12 pages (letter size, 2 cm margins, Times New Roman 12 pts)

Structure and contents:

- Summary
- Introduction (challenges in the field, possible approaches, choice of the subject and its justification)
- Scientific description of the fabrication technique – principle of operation, background theory, experimental set up, advantages and disadvantages, open questions
- Conclusions
- Bibliography – papers from refereed journals

Evaluation:

Scientific depth - 50%
Structure, clarity, language – 30%
Pertinence of the subject, justification and critical sense – 20%

Deadlines:

Choice of the subject: ..... **28 January**
Summary (150 words) and list of references: **11 February**
Report and presentation: ..... **11 March**

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Project 2: Design of an optical filter (20%)

Specific requirements:

Deliverables: Report, maximum 10 pages (letter size paper, 2 cm margins, Times new roman 12 pts)

Structure and contents:

- Introduction – describe the choice of the specific filter
- Optical specifications of the filter: spectral characteristics in T and R, tolerances
- Methodology of the design (architecture, materials, optimization,…)
- Discussion of the performance and sensitivity to the fabrication process
- Conclusions

Deadlines:

Choice of the filter: .. **25 February**

Report: …… **25 March**

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Specific requirements:

Project 3: Bibliographic research on a specific application of the nanoengineering of thin films; report and presentation (30% + 10% = 40%)

Deliverables: Report - maximum 20 pages (letter size, 2 cm margins, Times New Roman 12 pts), presentation - 20 minutes

Structure and contents:

- Summary
- Introduction (challenges in the field, possible appoaches, choice of the subjet)
- Scientific description of the fabrication technique – principles of operation, background theory, experimental set up, advantages and disadvantages, open questions
- Conclusions
- Bibliography – papers from refereed journals

Evaluation:

Scientific depth - 50%
Structure, clarity, language – 30%
Pertinence of the subject, justification and critical sense – 20%

Deadline:

Choice of the subject: ..... **18 February**
Summary (150 words) and list of references: **18 March**
Report and presentation: ..... **19 April**

References:

- "Materials Science of Thin Films", M. Ohring, Academic Press, New York 1992 (1st edition), 2002 (2nd edition)
- "Handbook of Deposition Technologies for Films and Coatings", R.F. Bunshah, ed., 2nd edition, Noyes Publications, Park Ridge, 1994. P.M. Martin, ed., 3rd edition, Elsevier, 2010;
- "Handbook of Nanotechnology", B. Bhushan, ed., Springer, Berlin, 2003.
- ''Handbook of Thin Film Process Technology'', D.A. Glocker and S.I. Shah, eds, Institute of Physics, Bristol, 2002.
- S. Larouche, J.-M. Lamarre, L. Martinu, "Guide de rédaction de rapports de laboratoire et de projet pour les cours de génie physique à l'École polytechnique de Montréal", École Polytechnique, Montréal, 2002.

International journals

Nature,
Thin Solid Films
Journal of Vacuum Science and Technology
Surface and Coating Technology
Journal of Applied Physics
Applied Physics Letters
Physical Review B
Physical Review Letters
Applied Optics
Optical Engineering
Solar Energy Materials and Solar Cells
Wear….

Societies:

American Vacuum Society (AVS)
Society of Vacuum Coaters (SVC)
Materials Research Society (MRS) ….