

Syllabus of surface characterization and modification of biomaterials

Professor Hamid Mirzadeh Course Taught

(3 units)

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I- Novel Techniques to Study Biomaterial Surface

- (Surface Chemistry, Surface Physical Properties, Surface Energy, Surface Morphology, Surface Roughness, Crystallinity and Mechanical Behaviors):
- 1-X-ray Photoelectron Spectroscopy (XPS) or Electron Spectroscopy for Chemical Analysis (ESCA)
 - 2-Auger Electron Spectroscopy (AES)
 - 3-Time-of-Flight Secondary Ion Mass Spectrometry (TOF-SIMS)
 - 4-Infrared Techniques (FTIR) and Attenuated Total reflectance Spectroscopy (ATR-FTIR)
 - 5-Raman Spectroscopy
 - 6-Transmission Electron Microscopy (TEM)
 - 7-Scanning Electron Microscopy (SEM)
 - 8-Energy Dispersive X-ray Analysis (EDXA)
 - 9-Static Contact Angles and Wilhelmy Balance (DCA)
 - 10-Surface Tension Measurements
 - 11-Scanning Tunneling Microscopy (STM)
 - 12-Atomic Force Microscopy (AFM)
 - 13-Ellipsometry
 - 14-X-ray Fluorescence (XRF)
 - 15-X-ray Diffraction (XRD)
 - 16-Porosimetry (MIP)
 - 17-Dynamic Mechanical Thermal Analysis (DMTA)
 - 18-Surface Charge Measurements (Zeta-Potential)
 - 19-Friction Coefficient Measurements
 - 20- Scanning Nearfield Optical Microscopy (SNOM)

II-Surface Modification Techniques for Biomaterials

- 1-Vapor Deposition (PVD, CVD)
- 2-Plasma Treatment (cleaning, deposition)
- 3-Laser Surface Modification
- 4-Sol-Gel
- 5-Chemical and Photochemical Modification and Immobilization of Molecules
- 6-Self-Assembly Monolayer (SAM)
- 7-Surface Modifying Additives (SMA)
- 8-Solvent Cast Films
- 9-Langmuir-Blodgett Technique 9

General Consideration for each Course:

Lectures (3h/week): basics, application, case studies

Exercises (home work)/Questions addressed

References:

- **ISO 10993 STANDARDS (ISO/ANSI/AAMI Standard 10993)**
 - <http://www.fda.gov/>
 - **-Annual Review of Biomedical Engineering Biomaterials: Been There, Done That, and Evolving into the Future Buddy D. Ratner Departments of Bioengineering and Chemical Engineering, University of Washington, Seattle, Washington 98195, USA, June, 2019.**
 - **Biomaterials Science, An Introduction to Materials in Medicine, Third Edition, Buddy D. Ratner, et.al. AP, 2013.**
 - **Biomaterials an introduction, J.Park R.Lakes, Third Edition, Springer, 2007.**
 - **Principle of tissue engineering, Robert Lanza, et.al, AP, 2013.**
 - **Methods of Tissue Engineering, Anthony Atala, et.al. Gulf Professional Publishing, 2002.**
 - **Synthetic Biodegradable Polymer Scaffolds, Anthony Atala, David J. Mooney, Springer, 1997.**
 - **Biomaterial Surfaces:**
 - **Properties and Characterization**
 - **J.A. Hubbell, M. Heuberger,**
 - **J. Vörös, M. Textor**
 - **ETH Zürich / Department Materials**
 - **Lecturers WS 2002/2003**
- Biomaterial Surfaces: Properties and Characterization, J.A. Hubbell, M. Heuberger, J. Vörös, M. Textor, ETH Zürich / Department Materials, Lecturers WS 2002/2003**
- **Biomaterials an introduction, J.B.Park, AP. 1992.**
 - **Scaffolding In Tissue Engineering, 1st Edition, Peter X. Ma, Jennifer Elisseeff, CRC Press, 2005.**
 - **Novel Biomaterials for Tissue Engineering 2018,**
<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6321414/>
 - <https://www.idtechex.com/research/reports/tissue-engineering-2018-2028-technologies-markets-forecasts-000565.asp>
 - **Tissue Engineering journals, Parts A,B and C,**
<https://home.liebertpub.com/publications/tissue-engineering-parts-a-b-and-c/595/recommend>
 - **Springer Book series Termis, 2017- 2018.**
 - **Reference Journals:**
 - **JBMR**
 - **Biomaterials**

- Progress in Biomaterials
- Etc.