

Advanced Course in Dental Materials and Dental Engineering
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Lecture/Lab. Academic year 1,2 credits 2,4

[Keywords] Surface and Interface Science, Joining and Adhesion, Tissue Compatibility of Biomaterials

[Academics] Takashi Nezu, Masatoshi Takahashi

[Course aims]

Implants, restorations, and prostheses used in the oral cavity function by attachment and contact with biological tissues. In addition, restorations and prostheses, such as porcelain fused to metal crowns or resin veneer crowns, are prepared by fusion or adhesion of materials of different properties. To establish and functionalize a stable joint interface between materials and tissues or between different materials, it is essential to understand the structure and properties of the material–tissue interface at a molecular level, based on fundamental theories of surface and interface science. This course aims to develop a good understanding of the structure and stability of material–tissue interfaces, such as bone tissue–dental implant osseointegration and tooth–resin adhesion. Through this course, students will study surface modification techniques and material surface analytic methods, for the construction of functionalized bio-compatible interfaces. Students will also learn to join metallic and ceramic/resin materials and will master analytical techniques to investigate joint interfaces.

[Course objectives]

At the end of this course, students will be able to:

- (1) Explain the structure of the interface between various metallic or inorganic materials and bone tissue.
- (2) Explain the adhesion interface between the enamel or dentin and adhesive resins, as well as explain sophisticated surface treatments for teeth and their effects.
- (3) Execute some basic adhesion tests.
- (4) Analyze material surface structures at a molecular level.
- (5) Explain the adhesion between metallic and ceramic materials or between metallic and resin materials, including related appropriate surface treatments.

[Course content]

Class	Theme	Content	Academics
1	Attachment interfaces between oral implant materials and tissues (bone, connective tissue, epithelium)		Takashi Nezu Masatoshi Takahashi
2	Surface treatments using titanium and its alloys for oral implants		Takashi Nezu Masatoshi Takahashi
3	Appearance and properties of enamel, dentin, and the adhesive resin interface, and its aging		Takashi Nezu Masatoshi Takahashi
4	Practice of tooth surface treatment and adhesion test on teeth		Takashi Nezu Masatoshi Takahashi
5	Joining between metallic and ceramic materials: surface treatment methods and joining interface appearance		Takashi Nezu Masatoshi Takahashi
6	Joining between metallic and resin materials: surface treatment methods and joining interface appearance		Takashi Nezu Masatoshi Takahashi
7	Practical evaluation of water resistance of adherents		Takashi Nezu Masatoshi Takahashi
8	Practical material surface analysis: SEM, X-ray photoelectron spectroscopy (XPS), laser Raman spectroscopy,		Takashi Nezu Masatoshi Takahashi

Class	Theme	Content	Academics
	FT-IR		

[Class implementation method]

Combination of face-to-face learning and distance learning

* Class implementation depends on the implementation policy of each department (graduate school), interdisciplinary studies, and school.

[Grading policies]

The students' overall grade in the class will be based on class attendance and reports.

[Textbook]

Students will be informed regarding the textbook.

[Reference book]

Same as above

[Preparation for course]

Students must survey the latest literature on adhesion techniques and surface analyses before attending classes because the advances in this field are quite remarkable.