

## Metallic Biomaterials (Metals)

### 1. Staffs and Students (April, 2010)

Professor	Takao HANAWA	
Associate Professor	Naoyuki NOMURA	
Assistant Professor	Hisashi DOI,	Yusuke TSUTSUMI
Research Assistant	Osamu FUKUSHIMA	
Secretary	Toshie NAKANISHI,	Yasuko SEKI
Graduate Student	Madoka MURAKAMI,	Akira SHINJO,
	SUYALATU,	Hitomi HIRUMA,
	Ryota KONDO	
Research Student	Kenichi IYAMA	

### 2. Purpose of Education

Metallic biomaterials play an important role as medical devices. Our laboratory mainly deals with effects of crystal structure, process, and thermal treatment on mechanical properties (e.g. strength or toughness). We also focus on structure and property of nanometer-scaled surface phenomena: Formation of living tissue on metals, especially, reactions between biomolecules or cells and metals, changes in surface oxide layers in living tissues, and electrochemical property of metallic biomaterials. The aim of the education is perfect understanding of metallic biomaterials, enabling students to select a proper material for medical treatments or researches.

### 3. Research Subjects

#### A) Bio-functionalization of metals with surface modification

Bio-functionalization on metals is investigated with surface treatment techniques, such as bio-functional molecule immobilization and electrochemical treatments.

#### B) Development of novel alloys for biomedical applications

Novel alloy systems for biomedical applications are explored from the viewpoint of mechanical properties and biocompatibility.

#### C) Development of porous metals composites with mechanical compatibility

Porous metal based composites having low Young's modulus with sustained release of inorganic ion are fabricated.

#### D) Development of Zr-based alloys for minimizing MRI artifacts

Zr-based alloys with high strength are investigated for the suppression of MRI artifact.

### 4. Publications

#### Original Articles

1. Tanaka Y, Matin K, Gyo M, Okada A, Tsutsumi Y, Doi H, Nomura N, Tagami J, Hanawa T. Effects of electrodeposited poly(ethylene glycol) on biofilm adherence to titanium. *J Biomed Mater Res A* 95: 1105-1113. 2010.
2. Tanaka Y, Matsuo Y, Komiya T, Tsutsumi Y, Doi H, Yoneyama T, Hanawa T. Characterization of the spatial immobilization manner of poly(ethylene glycol) to a titanium surface with immersion and electrodeposition and its effects on platelet adhesion. *J Biomed Mater Res A* 92: 350-358. 2010.
3. Suyalatu, Nomura N, Oya K, Tanaka Y, Kondo R, Doi H, Tsutsumi Y, Hanawa T. Microstructure and magnetic susceptibility of Zr-Mo alloys as-cast. *Acta Biomater* 6: 1033-1038. 2010.
4. Park J-W, Kim E-S, Jang J-H, Suh J-Y, Park K-B, Hanawa T. Healing of rabbit calvarial bone defects using biphasic calcium phosphate ceramics made of submicron-sized grains with a hierarchical pore structure. *Clin Oral Impl Res* 21(3): 268-276. 2010.
5. Tsutsumi Y, Nishimura D, Doi H, Nomura N, Hanawa T. Cathodic alkaline treatment of zirconium to give the ability to form calcium phosphate. *Acta Biomater* 6: 4161-4166. 2010.
6. Murakami M, Nomura N, Doi H, Tsutsumi Y, Nakamura H, Chiba A, Hanawa T. Microstructures of Zr-Added Co-Cr-Mo Alloy Compacts Fabricated by Metal Injection Molding Process and Their Metal Release in 1 mass% Lactic Acid. *Mater Trans* 51(7): 1281-1287. 2010.
7. Nomura N, Sakamoto K, Takahashi K, Kato S, Abe Y, Doi H, Tsutsumi Y, Kobayashi M, Kobayashi E, Kim W-J, Kim K-H, Hanawa T. Fabrication and Mechanical Properties of Porous Ti/HA Composites for bone Fixation Devices. *Mater Trans* 51(8): 1449-1454. 2010.

8. Oya K, Tanaka Y, Moriyama Y, Yoshioka Y, Kimura T, Tsutsumi Y, Doi H, Nomura N, Imai H, Kishida A, Hanawa T. Differences in the bone differentiation properties of MC3T3-E1 cells on polished bulk and sputter-deposited titanium specimens. *J Biomed Mater Res A* 94: 611-618. 2010.
9. Oya K, Tanaka Y, Moriyama Y, Yoshioka Y, Kimura T, Tsutsumi Y, Doi H, Nomura N, Imai H, Kishida A, Hanawa T. Differences in the bone differentiation properties of MC3T3-E1 cells on polished bulk and sputter-deposited titanium specimens. *J Biomed Mater Res A* 94: 611-618. 2010.
10. Otomo T, Matsumoto H, Nomura N, Chiba A. Influence of Cold-Working and Subsequent Heat Treatment on Young's modulus and Strength of Co-Ni-Cr-Mo Alloy. *Mater Trans* 51(3): 434-441, 2010.
11. Pecheva E, Pramatarova L, Hikov T, Fingarova D, Tanaka Y, Sakamoto H, Doi H, Tsutsumi Y, Hanawa T. Apatite-nanodiamond composite as a functional coating of stainless steel, *Surf Inter Ana* 42(6-7): 475-480, 2010.
12. Ohida M, Yoda K, Nomura N, Hanawa T, Igarashi Y. Evaluation of the static frictional coefficients of Co-Cr and gold alloys for cone crown telescope denture retainer applications. *Dent Mater J* 29: 706-712, 2010.

#### Review Article

1. Hanawa T. Biofunctionalization of titanium for dental implant, *Jpn J Dent Sci Rev*, 46: 93-101, 2010.
2. Nomura N. Artificial organs: recent progress in metals and ceramics, *J Art Org* 13(1): 10-12, 2010.

#### Book

1. Hanawa T. Biological reactions on titanium surface electrodeposited biofunctional molecules, *Interface Oral Health Science 2009*, Eds. Sasano T., Suzuki O, Springer, New York, 83-89, 2010.
2. Hanawa T. Overview of metals and applications. *Metals for Biomedical Devices*, Ed. Niinomi M, Woodhead, Publishing, Oxford, 3-24, 2010.