Approach for the project on advanced materials development and integration of novel structured metallic and inorganic materials by materials and structures laboratory of Tokyo Institute of Technology†

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KEY WORDS: (Advanced inorganic materials) (Novel structures) (Environment) (Energy) (Electronics) (Biomaterials)(MSL) (Tokyo Tech)

1. Introduction

The Materials and Structures Laboratory (MSL) of Tokyo Institute of Technology is one of the nationwide collaborative research institutes in Japan covering the fields of inorganic materials and building materials since 1996 [1]. The MSL performed the special collaborative project on Metallic Glass-Inorganic Materials Joining Technology Development (MGIMJTD) with two other nationwide collaborative research institutes, the Institute for Materials Research (IMR) of Tohoku University and the Joining and Welding Research Institute (JWRI) of Osaka University from 2005 to 2009 [2]. Based on a lot of fruitful results obtained by this special project, the MSL, IMR and JWRI agreed to progress the project to the second stage for realizing the outcomes of the first project by making a new group with three institutes specialized in the environment, Eco Topia Science Institute (ETSI) of Nagoya University, nanotechnology, Institute for Nanoscience and Nanotechnology (INN) of Waseda University, and bio-medical materials, Institute of Biomaterials and Bioengineering (IBB) of Tokyo Medical Dental University from 2010.

A new special project, Advanced Materials Development and Integration of Novel Structured Metallic and Inorganic Materials (AMDINSMIM) is strongly focused to four research fields, i.e. (1) environment and energy materials, (2) electronics materials, (3) bio and medical materials and (4) novel structured materials. Many topics will be performed by collaborative works with some member institutes in the AMDINSMIN project. Thus, MSL will have strong contact especially with the ETSI in the first research field, with the INN in the second research field, with the IBB and IMR in the third research field and with the JWRI in the fourth research field.

The organization of the project group in the MSL and research topics planned for this AMDINSMIN project are briefly introduced in this presentation.

2. Organization for the AMDINSMIM project in the MSL

The number of members joined in the last project was about 25, involving most of the academic members in the MSL. We especially encouraged the young members in the MSL to challenge new research topics considered from their fresh ideas.

In the present project, we selected only 17 members based on their applied proposals because the budget size for the MSL was greatly decreased. The project organization in the MSL is shown in **Fig. 1**. We have a steering committee for this project chaired by the director of the MSL. This committee receives the activity reports from the project group and gives advise to the group. The project group has one project leader and two sub-leaders to organize the project. The leader is Professor F.Wakai and sub-leaders are Professors T.Kamiya and N.Matsushita. The 17 project members are divided into the above mentioned four research fields, i.e. three members in the environment and energy materials, four members in the electronics materials, five members in the bio and medical materials and five members in the novel structured materials. We selected a head in each research field to effectively progress their research topics and organize their fields.

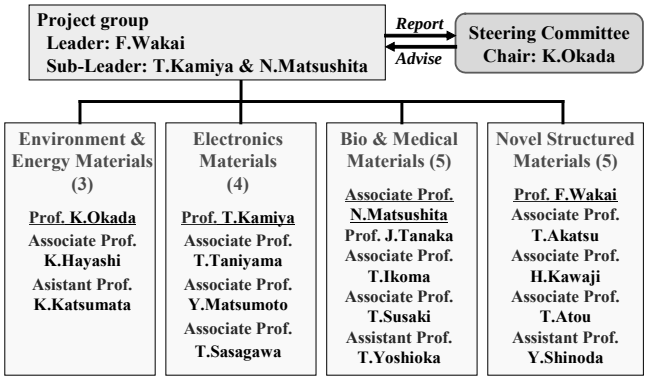

Fig. 1 Line-up for the project in the MSL.

† Received on 30 September 2010
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Transactions of JWRI is published by Joining and Welding Research Institute, Osaka University, Ibaraki, Osaka 567-0047, Japan

3. Research topics in the MSL

The main topics planned in this special project at the MSL are listed in **Table 1**.

Environment and energy materials: Since the main topics in this field are focused on the materials related to fuel cells organized by the ETSI, we will investigate a material for separators using metallic glasses [3]. On the topics related to the environment, a collaborative work on oxidation catalyst using mayenite type compounds [4] will be performed with the ETSI.

Electronics materials: Main part of the work in this field is preparation and evaluation of photonic, electronic and/or spintronic devices with some novel nanostructures by combinations of inorganic materials, semiconductors and/or metals [5-8]. Since these devices consist of multi-thin film nanotextures, strong collaboration with the INN group is essentially important.

Bio and medical materials: Preparation and biomedical evaluation of Ti based bulk metallic glasses (BMGs) having nanostructured bioactive surfaces is the main topic and this will be performed by collaborative team of the MSL, IMR, IBB and JWRI. The MSL will mainly take a part of preparation of nanostructured bioactive surfaces on the Ti-BMGs using hydrothermal and/or electro-hydrothermal techniques [9,10]. Evaluation of bioactivity of oxide thin films controlling their atomic precisions [11] is a new challenging work in this field.

Novel structured materials: Relatively wide topics are proposed in this field but main topics will be focused on control of interfaces for developing novel structured materials [12-14]. The topics related to joining of different materials will be performed collaboratively with the JWRI.

4. Conclusions

In the present project, clear outcomes developed to actual materials contributing to our society are strongly requested. Strong collaborations with the six member institutes are very important to enhance our research works toward the goal.

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Table 1 The research topics of the project in the MSL

Field	Name	Title of the topics
Environment and Energy Materials	K.Okada	Surface treatment of metallic glasses and its property change for fuel cell applications
	K.Hayashi	Catalytic properties of mayenite type $Sr_{12}Al_{14}O_{33}$ (S12A7)
	K.Katsumata	Environmentally benign optical materials by novel nanostructures
Electronics Materials	T.Kamiya	Inorganic material/metal/semiconductor novel structures for photonic and electronic devices
	Y.Matsumoto	PLD synthesis of metallic glass/oxide novel structures and its new function as environmental catalysts
	T.Taniyama	Control of magnetic anisotropy in ferromagnetic metal/ferroelectrics/semiconductor hetero-structures for spintronic devices
	T.Sasagawa	Impacts of anisotropic lattice deformations on the electronic functions at the heterointerfaces
Bio and Medical Materials	N.Matsushita J.Tanaka T.Ikoma T.Yoshioka	Ti based bulk metallic glasses having nanostructured bioactive surfaces and its applications for artificial dental roots
	T.Susaki	Medical application of oxide thin films with atomic precision
Novel Structured Materials	F.Wakai	Joining process technology of interfaces between different phases
	T.Akatsu	Superior ceramic coatings on a metal substrate through plasma electrolytic oxidation
	Y.Shinoda	Development of creep resistant titanium carbide cermets
	H.Kawaji	Relaxization mechanisms of metallic glasses and development of high functional materials
	T.Atou	Shock-assisted joining between metallic glasses and ceramics