## 2.2.7 Laboratory : Biomateirals Desigin

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| Member : | Professor | Nakano, Takato, D. Agric. Sci. |
| | Senior Lecturer | Nakamura, Masashi, D. Agric. Sci. |
| | Assistant Professor | Murata, Koji, D. Agric. Sci. |
| | Doctor's program | 1 |
| | Master's Program | 6 |
| | Undergraduate | 3 |

**A. Research Activities (2009.4-2010.3)**

**A-1. Main Subjects**

a) Characterization of physical properties of wood

Physical properties of wood such as relaxational behavior, fatigue properties, and water adsorption are affected by ultrastructure and various factors, for example moisture content, temperature and so on Effects of theie factors on physical properties are thermodynamically researched by relating to ultra-structure of wood. Prediction of fatigue life of wood is analytically examined on the basis of various factors associated in fatigue life. Additionally, relationship between adsorption water and the above properties is also researched.

b) Swelling mechanism of cell wall and physical properties

Swelling behaviour of cell wall with water adsorption is tighjtly related to physical properteris of wood and gives many information. Relationship between adsorption water and swelling behaviour is examined using a model of cell wall. Swelling behaviour of wood and wood cell walls is also visualized and analyzed by using digital image correlation method.

c) Fracture mechanics of anisotropic materials, and strength designing for wooden structural elements

Metal and plastics are isotropic materials but wood is an anisotropic material. Strength of wood parallel to the grain is extremely high because of its cellulose filament winding around the cell walls. This is the reason why wood is light and strong. Because of this reason wood is consequently used for building and furniture in large quantities. Mechanics of anisotropic material is necessary for designing of these structural elements. Real stresses-strains curve is measured using image correlation technique.

d) Nondestructive grading of lumber

Wood has large deviation in strength like as other natural products. Since strength of fifth percentile exclusive limit is generally used for strength designing, nondestructive grading is important for effective use of wood resources. Thermal changes during repeated bending are tried to use for detecting defects (knot and others), and deflection distribution curves and optical properties are also used for evaluating strength.

e) Properties of wood as sensory stimuli to human

Wood is one of the most friendly and comfortable material for human. Dominant factors of such effects are investigated scientifically and its application to interior designing are studied. For example; i) Investigation on characteristics of wood as visual stimuli, especially, grain figure, color and glossiness, and its application to the designing of interior space and furniture. ii) Generation of wood grain figures by computer graphics. iii) Formulation of relations between psychological impressions, especially 'natural' and 'comfortable' images and physical characteristics of visual images. iv) Evaluation of visual inducement of wood by using eye-tracking method.

**A-2.Publications and presentations**

a) Publications

Books

- Nakamura, M.: Merits and demerits of attractiveness. Encyclopedia on Phsyiological Anthropology by Japan Society of Physiological Anthropology. p209-213, Maruzen, Tokyo, 2009

Original Papers

- Nakamura, M., Matsuo, M., Nakano, T: Determination of the change in appearance of lumber surfaces illuminated from various directions, Holzforschung, 64 (2); 251-257 (2010)

- Murata, M., Umemura, K., Kaimoto, T., Kaimoto, T., Okuda, K.: "Glulam using Chitosan Adhesive" Wood industry, 65 (2); 69-72 (2010)

- Y Ohmae and T. Nakano: Water adsorption properties of bamboo in the longitudinal direction, Wood Sci. & Technol, 43; 415-422 (2009)

- Kawamura, S., Ohata O., Murata, K.: Panel Shear Performance of Bearing Wall Made of Diagonal Plywood, Journal of the Materials Science, Japan, 58(4)；208-285, 2009

- Nagai, H., Murata, K., Nakano, T.: Defect detection in lumber including knots using bending deflection curve: comparison between experimental analysis and finite element modeling, Journal of wood science, 55(3); 169-174 (2009)

Reports

- Nakamura, M.: Why does wood evoke the feeling of warmth to us?, "The house of healing made of the lumber harvested at Kitayama, Kyoto", LEAF publications, 94-95, 2009
- Nakamura, M.: I tried self-measurement, Wood industry, 65 (3); 131-134, 2010

b) Conference and seminar papers presented

- The 60th Annual Meeting of Japan Society of Physiological Anthropology, Sapporo, Jun. 6-7, 2009: 1 presentation (Nakamura)
- The 27th Annual Meeting of Japan Wood Technological Association, Kumamoto, Oct. 8-10, 2009: 2 presentations (Murata)
- The 53rd Japan Congress on Materials Research, Kyoto, Oct. 19-21, 2009: 1 presentation (Murata)
- The 7th Forum of Sekisui Chemical on " Manufacturing Based on Learning from Nature", Kyoto, Oct. 21, 2009: 1 presentation (Nakamura)
- The 60th Annual Meeting of Japan Wood Research Society, Miyazaki, Mar. 17-19, 2010: 10 presentations (Nakano, Nakamura, Murata)

**A-3.Off-campus activities**

Membership in academic societies

- Nakano, Takato, D.Agric.Sci : The Japan Wood Research Society, The Society of Materials Science, Japan, The Society of Rheology, Japan, The Cellulose Society of Japan
- Nakamura, Masashi, D.Agric.Sci : The Japan Wood Research Society (Member of the committee for information processing, Secretary of the Division of Living Comfort, Member of the committee for finance), Japan Society of Physiological Anthropology (Trustee for homepage, Councilor), Wood Technological Association of Japan (Member of the planning committee of Kansai Branch)
- Murata, Koji, D.Agric.Sci : The Society of Matreials Science, Japan (Councilor, Committee member of the Division of Wood Based Materials, Editorial board member of the journal), Wood Technological Association of Japan (Secretary of the planning committee of Kansai Branch, Secretary of the committee for fast growing trees of Kansai Branch), The Japan Wood Research Society (Editorial board member of the journal)

Research grants

2.Other Research Grants

- Sekisui Chemical Grant Program for Research on Manufacturing Based on Learning from Nature : Nakamura, Masashi : Learning from wood grain pattern to develop natural design methodology
- NEDO Industrial Technology Research Grant Program : Murata, Koji : Environment Friendly Wood-based Material and New Grading System

**B.Educational Activities(2009.4-2010.3)**

**B-1.On-campus teaching**

a) Courses given

- Undergraduate level : Basic Science for Forest and Biomaterials III (Nakano), Forest and Biomaterials Science III (Nakano), Properties of Biomaterials (Nakano), Wood and Timber Construction (Nakamura), Practice in Biomaterials Design (Nakano, Nakamura, Murata), Information Technology in Forest and Biomaterials Science (Nakamura, Murata), Laboratory Course in Forest and Biomaterials Science III (Nakamura, Murata), Laboratory Course in Physics of Forest and Biomaterials (Nakamura, Murata), Laboratory Course in Wood Technology (Nakamura, Murata), Architectural Design and Drawing (Nakamura)
- Graduate level : Seminar in Biomaterials Design (Nakano, Nakamura, Murata), Laboratory Course in Biomaterials Design (Nakano, Nakamura, Murata), Biomaterials Design II (Nakamura)

**B-2.Off-campus teaching etc.**

<u>Open lectures, etc.</u>

- Nakano, Takato: "Interesting topics of physical properties of wood" in Lecture meeting of The Cellulose Society of Japan Tohoku-Hokkaido Branch, Sapporo, 17 Dec., 2009 (lecture)
- Nakamura, Masashi: "Probe of aesthetic property of wood by using image analysis" in special lecture of Hokkaido Forest Products Research Institute, Asahikawa, 4 Jun., 2009 (lecture)
- Nakamura, Masashi: “Wood and living environment” in wood science seminar of wood technological association Japan Kansai branch, Sakurai, 5 Dec. 2009 (lecture)
- Nakamura, Masashi: “Wood as Software” in Regular meeting of the Youth and Manhood Managers in Wood Industry Nagoya, Nagoya, 27 Feb. 2010 (lecture)

- Murata, Koji: “Report of Chinese Eucalyptus lumber” in the 3rd Symposium by Research group of Utilizing Fast Growing Tree, Kyoto, Aug. 28, 2009 (presentation)