EuroSciCon

# DAY 1

## Keynote Forum


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Hiromi Nakano, Nano Res Appl 2019, Volume 05

# Photoluminescence- and electric-properties using a smart material of Li-(Nb,Ta)-Ti-O system

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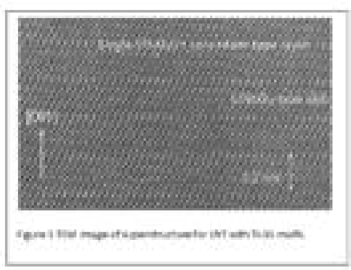
In the $Li_2O$-$M_2O_5$-$TiO_2$ system, $Li_{1+x-y}M_{1-x-3y}T_{ix+4y}O_3$ (M = Nb, or Ta, 0.06≤x≤0.33, 0≤y≤0.175 (LMT) forms with a superstructure, and this is known as a smart material. The superstructure is formed by periodical insertion of an intergrowth layer of corundum-type $[Ti_2O_3]^{2+}$ in a matrix having a trigonal structure during the grain growth for a long sintering time. To apply this unique structure as a host material of phosphor, new phosphors have been investigated based on LMT or related structures made by a conventional electric furnace and millimeter-wave heating. Rare earth ($RE^{3+}$: Eu, Er, Tb, Tm, or Dy) doped LMT phosphors with various emitted colors were successfully synthesized. Especially, we synthesized a new red phosphor based on the quaternary $Li_{1+x}(Ta_{1-z}Nb_z)_{1-x}Ti_xO_3$ (LTNT, 0≤x≤0.25, 0≤ z≤1.0) solid solution. An $Eu^{3+}$-doped LTNT has been prepared in a conventional electric furnace. Interestingly, a bright red emission due to the hypersensitive $^5D_0$-$^7F_2$ transition in $Eu^{3+}$ was observed under direct excitation of the 4f electron at 400 nm. In the LTNT host material, the most effective activator was found to be Eu ion and an internal quantum efficiency of 98% was achieved. We found that the high PL intensity was closely related to the polyhedral structure of the [Li (Eu) $O_{12}$] in the host material. Still more, toward application of the unique qualities of an electro-ceramic, we fabricated oriented the solid solution for Nb system (LNT) balk ceramics by slip casting in a strong magnetic field of 12 T using various sizes of particles. Anisotropic electric properties were found along the c-axis, which were caused by a superstructure. We first clarified the mechanism showing that the anisotropic *Qf* value was caused by the anisotropic electron conductivity and the anisotropic bonding strength in the superstructure.



**Recent Publications**

1. H Nakano, K Konatsu, T Yamamoto and Y Furuta (2018) Rapid sintering of $Li_2O$-$Nb_2O_5$-$TiO_2$ solid solution by air pressure control and clarification of its mechanism. Materials 11: 987.

2. H Nakano, K Kamimoto, N Yokoyama and K Fukuda (2017) The effect of heat treatment on the emission color of P-doped Ca2SiO4 phosphor. Materials 10 (9):1000.
3. H Nakano, S Furuya, M Yuasa, T Suzuki and H Ohsato (2017) Fabrication and anisotropic electronic property for oriented $Li_{1+x-y}Nb_{1-x-3y}Ti_{x+4y}$ solid solution by slip casting in a high magnetic field. Adv. Powder Technol. 28 (2017): 2373-2379.
4. H Nakano, N Yokoyama, H Banno and K Fukuda (2016) Enhancement of PL intensity and formation of core-shell structure in annealed $Ca_{2-x/2}(Si_{1-x}P_x)\ O_4{:}Eu^{2+}$ phosphor. Mater. Res. Bull. 83:502-506.
5. S Furuya, H Nakano, N Yokoyama, H Banno and K Fukuda (2016) Enhancement of photoluminescence intensity and structural change by doping of $P^{5+}$ ion for $Ca_{2-x/2}(Si_{1-x}P_x)O_4{:}Eu^{2+}$ green phosphor, J. Alloys and Compds. 658:147-151.

## Biography

Hiromi Nakano is working as a Professor in the Department of Environmental and Life Sciences, and Cooperative Research Facility Center at Toyohashi University of Technology. She has completed her B S, M S and Dr. (Eng.) at Toyohashi University of Technology, Japan in 1981, 1983 and 2000, respectively. She joined Murata Manufacturing Co., Ltd. in 1983 and transferred to Ryukoku University in 1989. She joined the Cooperative Research Facility Center at Toyohashi University of Technology as an Associate Professor in 2009 and currently, she is working as a Professor and Presidential Advisor (Gender Equality). In 2010, she received the 64th *CerSJ* Award for Academic Achievements in ceramic science and technology. Her current interest is in the synthesis of new phosphors and characterization of ceramic materials using a transmission electron microscope to control the material properties and for the design of new materials.

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Armin Mehrabi, Nano Res Appl 2019, Volume 05

# Development of smart materials and structures should anticipate evolution of structural systems and construction methods

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To facilitate application of smart materials and structures, one must consider the evolution of structural systems and construction methods. In other words, if we work on developing smart materials and structures having in mind current conventional structures and construction methods, by the time our product is ready, the structures and systems might have evolved to something different and the implementation might become obsolete. As an example, there is a substantial movement toward accelerated construction methods. One such approach deals with Accelerated Bridge Construction (ABC) that is defined as design, planning and construction methods to organize and arrange construction activities for new bridges, as well as repair, replacing and rehabilitating of existing bridges so that onsite construction time and mobility impacts are reduced, and public and worker's safety is enhanced. The method relies heavily on using prefabricated modular bridge elements and assemblies that addresses some of the major drawbacks of the conventional bridge construction methods including delays to allow concrete curing, time constraints due to sequential construction, traffic interruptions and safety issues, compromise in quality for *in situ* activities, dependency on weather, etc. Recent tendencies toward automation and robotics also agrees well with the ABC notion. The inherent unique characteristics of ABC may also require unique materials and technologies for making the structure smart. This presentation attempts to discuss the characteristics of ABC and expectations on materials and technologies that would facilitate construction and maintenance of such structures in a smart manner.

### Biography

Armin Mehrabi is an Associate Professor and ABC-UTC Director of Research in the Civil and Environmental Dept. of Florida International University (FIU). Before joining FIU, he served as the President of the Bridge Engineering Solutions specializing in inspection, evaluation, cable vibration and wind assessment, health monitoring, and rehabilitation of cable-supported bridges. He has published extensively on inspection and evaluation of bridges, laboratory testing and seismic analysis of masonry and infilled frames. His current research includes NDE, health monitoring and maintenance decision making, development of guidelines for ABC substructure selection, redundancy of steel box girder bridges, and precast prestressed pile splices.

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