



## Prof. Yoshinao MISHIMA

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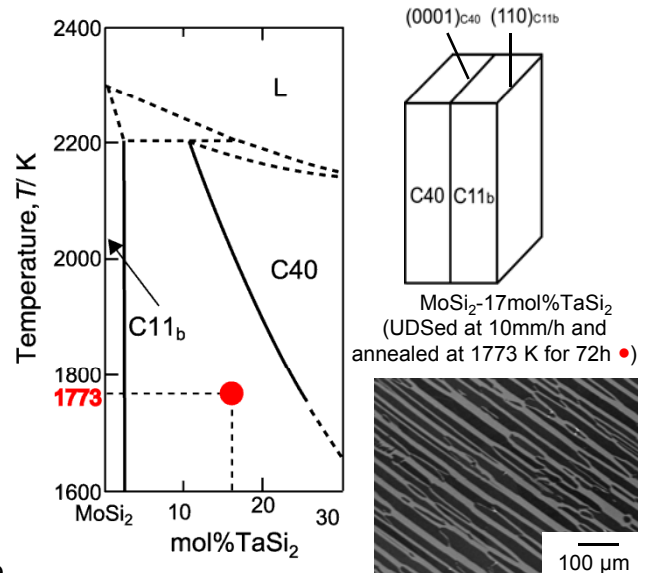
Research field: Alloy design of materials for various  
energy conversion systems



### Research topics conducted within the G-COE project

1. Design of high temperature structural materials based on Nb and Mo silicides
2. Establishment of design concept of a thermoelectric material with a high efficiency  
- Alloy design of Skutterudite  $\text{CoSb}_3$  for improved thermoelectric figure of merit -

Aim of the current research is to develop materials for effective utilization of energy resources, which consists of 1) Design of high temperature structural materials for energy conversion systems, and 2) Design of thermoelectric materials to effectively generate electricity out of heat waste. For the former scheme, alloy design and microstructure control by unidirectional solidification have been attempted in Nb- and Mo- alloys in order to achieve a superior mechanical properties to a commercial Ni-base superalloy at temperature over 1600 K. The material will improve the electricity/fuel conversion efficiency of an existing gas turbine engine and will reduce  $\text{CO}_2$  exhaust at the same time. For the latter scheme, a series of work has been going on in various intermetallic semiconducting materials to establish the design scheme of thermoelectric materials with high efficiency. They include choice of crystal structure, proper substitution of atoms on the lattice sites by additional elements with different electrical properties and atomic sizes to control the carrier density and the thermal conductivity.. An example of such a successful alloy design has been made on Skutterudite  $\text{CoSb}_3$ .



**$\text{MoSi}_2/\text{TaSi}_2$  aligned lamellar structure obtained by UDS using an OFZ furnace**

### Representative publications

1. N. Sekido, F. G. Wei, Y. Kimura, S. Miura and Y. Mishima : Orientation relationship between Nb and  $\text{Nb}_5\text{Si}_3$  (D81) phases in the eutectoid lamellar microstructure ; Philosophical Magazine Letters, Vol. 86, No. 2, February (2006), 89-98
2. Y. Kimura, M. Komiyama, Y. Mishima: Microstructure and mechanical properties of  $\text{MoSi}_2/\text{TaSi}_2$  two-phase alloys; Intermetallics, 14, (2006) ,1358-1363
3. S. W. Kim, Y. Kimura and Y. Mishima: Effect of partial La filling on high temperature thermoelectric properties of  $\text{IrSb}_3$  based skutterudite compounds; Journal of Electronic Materials, 33[10] (2004), 1156-1161.