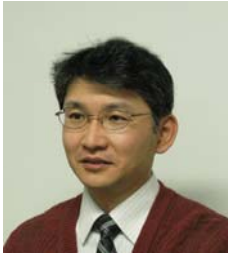


【Grant-in-Aid for Scientific Research(S)】
Science and Engineering (Engineering II)



Title of Project : Anomalies of martensitic transformations appearing at very low temperatures: their origin and universality

Ryosuke Kainuma
 (Tohoku University, Graduate school of Engineering,
 Professor)

Research Area : Engineering

Keyword : Martensitic transformation, Superelasticity, Low temperature

【Purpose and Background of the Research】

Recently, some anomalies of martensitic transformations (MTs), such as strain glass in the NiTi alloy, kinetic arrest phenomenon and heating-induced MT in NiCoMnIn alloys (see Fig.1), have been found at very low temperatures. In this study, for some typical shape memory alloys (SMAs), including NiTi and NiMnIn-based alloys, basic physical properties at temperatures below liquid nitrogen temperature (LNT) will be examined and the microstructures will be also observed by using advanced TEM techniques in order to clarify the origin and the universality of the abnormal properties observed at low temperature in NiTi and NiCoMnIn alloys. Through this project, practical superelastic (SE) materials operating at very low temperatures will also be developed.

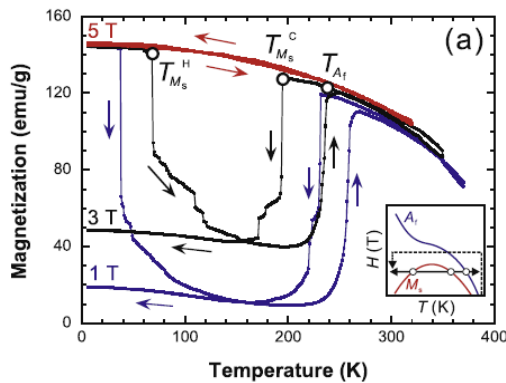


Figure 1 Heating-induced forward transformation observed in NiCoMnIn alloy.

【Research Methods】

For many kinds of SMAs, such as NiTi, CuAlMn, NiMnIn, FeMnGa, CoFeAl and TiNb, basic physical properties, including magnetic and mechanical properties, and the microstructure in the temperature region from 10 to 200 K are examined by ER, DSC, VSM, SQUID, Instron-type machine and TEM. Especially, an Instron-type machine and a special TEM-holder for use at low temperatures will be prepared for this project and the characteristic features of stress-induced MTs and premartensite structures will be determined. Some thermodynamic and kinetic simulations will also be used to understand the experimental results.

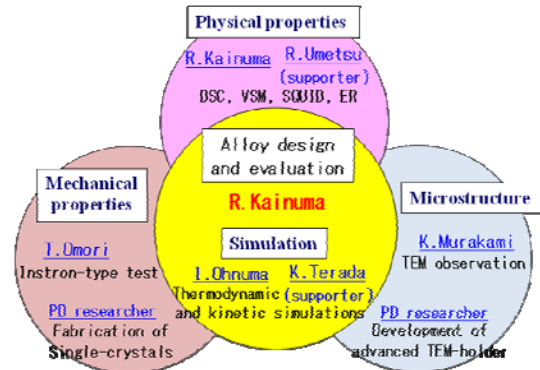


Figure 2 Research members and tasks

【Expected Research Achievements and Scientific Significance】

Because NiTi alloys show no MT at low temperatures, there have been few reports on the mechanical properties in the temperature region below LNT. By the present project, the basic mechanical properties of many typical SMAs will be first clarified. If a practical SE material for low-temperature operation is developed, it may be used as sealing devices for low-temperature facilities.

【Publications Relevant to the Project】

- Xiao Xu et al., “Anomaly of critical stress in stress-induced transformation of NiCoMnIn metamagnetic shape memory alloy”, Appl. Phys. Lett. 95,(2009) 181905
- W. Ito et al., “Kinetic arrest of martensitic transformation in the NiCoMnIn metamagnetic shape memory alloy”, Applied Physics Letters, 92, (2008) 021908

【Term of Project】 FY2010-2014

【Budget Allocation】 167, 000 Thousand Yen

【Homepage Address and Other Contact Information】

<http://www.material.tohoku.ac.jp/~seigyolab.html>
 kainuma@material.tohoku.ac.jp