Summary of Dissertation

Title: A study on electro-magnetic measurements of mechanically-induced martensite in Fe-based alloy during deformation at various strain rate

(変形中の鉄基合金を対象とした様々なひずみ速度における力学場誘起マルテンサイト相電気磁気測定法の研究)

曹 博

This dissertation investigated the electro-magnetic measurements of mechanically-induced martensite in Fe-based alloy during deformation at various strain rates. For the stress-induced martensitic transformation (SeIMT), which is a kind of mechanically-induced martensitic transformation, the strain rate dependency and tension-compression asymmetry of SeIMT behavior in Fe-28Mn-6Si-5Cr shape memory alloy (Fe-SMA) were studied through the measurement method of volume resistivity. As a result, the negative rate sensitivity in the volume resistivity was observed under tension and compression. Besides, compared with tension, lower shape recovery strain related to the lower volume fraction of stress-induced ε'-martensite under compression was obtained in Fe-SMA.

On the other hand, for the strain-induced martensitic transformation (SaIMT), which is another kind of mechanically-induced martensitic transformation, the strain rate sensitivity of SaIMT behavior in SUS304 metastable austenitic stainless steels was estimated by the established measurement method of relative magnetic permeability using an AC and DC supply. As a result, the negative rate sensitivity of relative magnetic permeability using AC and DC voltage was found. Besides, this negative rate sensitivity of volume fraction of martensite was also confirmed by using SEM and XRD.

Furthermore, the relationship between the electric and magnetic properties of martensite during deformation was discussed. A relatively good consistency of the volume resistivity and relative magnetic permeability by using the established electro-magnetic measurements could be seen.

Not only that, the grain size effect on shape memory effect (SME) in Fe-SMA was studied. It could be found that the negative effect of grain refinement on the SME. Besides, the negative rate sensitivity of SME could be observed under tensile tests for each grain size.