Experimental Report

Proposal: **1-01-132** **Council:** 10/2012

Title: Early stages of precipitation in Ni-rich near-equiatomic Ni-Ti shape memory alloys

This proposal is resubmission of: 1-01-119

Researh Area: Materials

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Samples: NiTi
Ni 51% and Ti49 %

Instrument	Req. Days	All. Days	From	To
D22	2	2	13/05/2013	15/05/2013

Abstract:

Pseudoelastic NiTi-based shape memory alloys (SMA) of near-equiatomic composition are technologically very important for bio-medical applications. One of the methods of improving pseudoelasticity of this alloy is by low-temp. aging which is known to give rise to a very fine precipitates that evolve into Ni4Ti3 or Ni14Ti11 on prolonged exposure. However, very little is known about the early stages of this precipitation process. Small-angle neutron scattering (SANS) is especially suited to study these early stages in this system as Ni and Ti have scattering lengths of opposite signs and thus, offer extraordinarily large scattering contrast. The current study will explore the early stages of precipitations in Ni51Ti49 using SANS (at 300 C, both ex-situ & in-situ), in combination with 3D atom probe tomographic (3DAP) microscopy. Combination of these complementary techniques would provide valuable insight into early stages of precipitation and help design better pseudoelastic NiTi-based SMA for bio-medical applications.

<u>Preliminary experimental report</u> (1-01_132)

SANS study of early stages of precipitation in NiTi alloy: To explore early stages of precipitation in Ni-rich NiTi alloys, Small Angle Neutron Scattering (SANS) experiments have been carried out in combination with complementary techniques like 3-D Atom Probe Tomographic Microscopy (3DAP) and TEM (Fig.1 a-c). SANS is particularly suitable to study early stages of precipitation in this system, as Ni and Ti have scattering lengths of opposite signs and thus, offer extraordinarily large scattering contrast. In the present study, early stages of precipitations in Ni51Ti49 samples, both in as-solutionized state and after aging at 300^0, 350^0 and 400^0 C for different durations (1h, 1.5h, 3h, 6h and 18h) have been investigated by SANS at Institut Max Von Laue – Paul Langevin (ILL), Grenoble, France (Fig.2 a-c). A time-resolved in-situ SANS experiment has also been performed on solutionized Ni51Ti49 sample at 300^0 C. Four different detector distances (1.8m, 4m, 8m and 17.6m) have been used to cover the entire range of length scales of interest. Detailed analysis is underway.

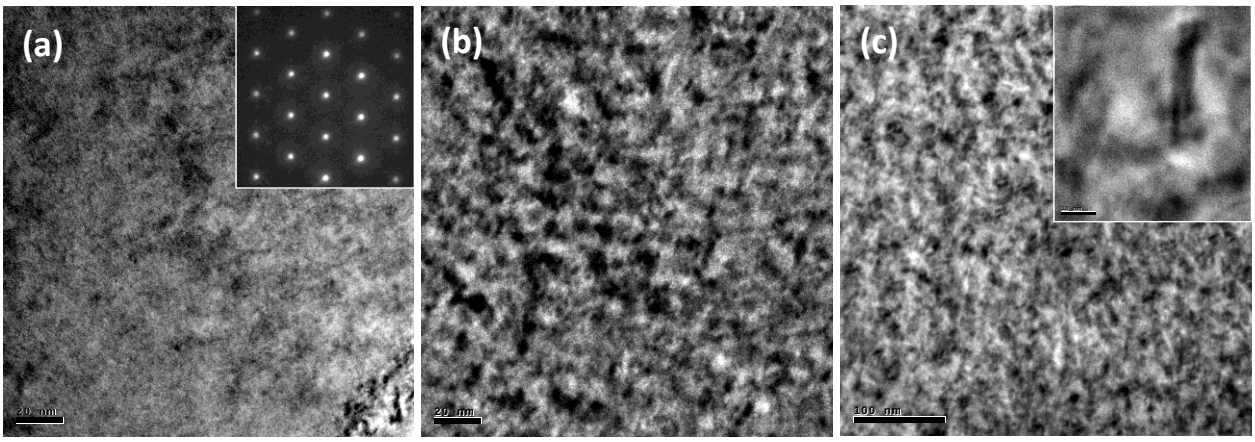

Fig.1. BF micrographs in <111>$_{B2}$ zone of Ni51Ti49 samples aged at (a) 300 C for 3 h; (b) 300 C for 6 h and (c) 350 C for 18 h respectively.

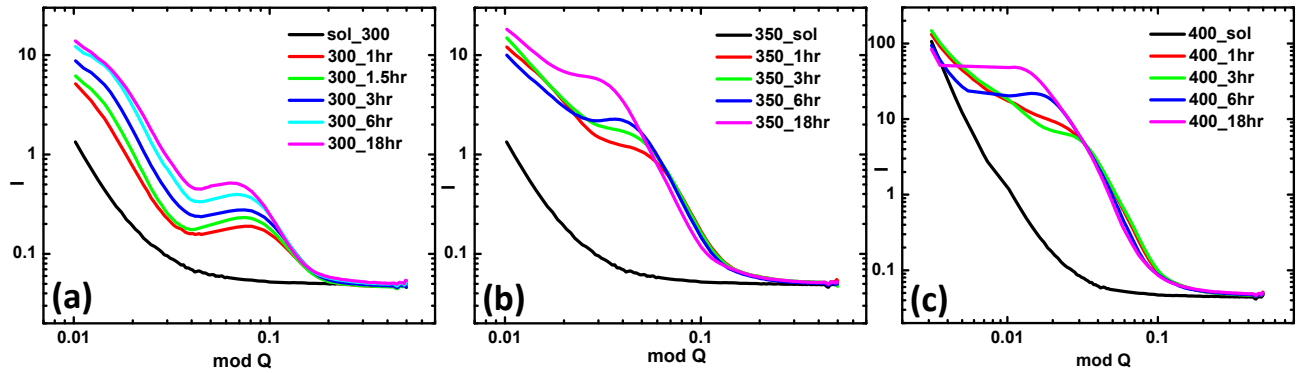

Fig.2. Ex-situ SANS analysis of Ni51Ti49 samples aged for different durations at (a) 300 C; (b) 350 C and (c) 400 C respectively.