Project 17: Characterization of Microstructure Evolution in Nickel-Titanium-Hafnium Intermetallics

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Project Duration
PhD: August 2015 to August 2019

Problem: Ni-Ti alloys experience high residual stress due to rapid quenching processes. The result is cracking and machining distortion. Not quenching leads to low hardness.

Objective: Elucidate the effect of Hf ternary alloying on metallurgy and bearing element performances.

Benefit: Hf-alloying could lead to reduction in residual stress by eliminating the need for rapid cooling while retaining high strength and hardness levels of quenched binary Ni-Ti.

Recent Progress

- Rolling contact fatigue (RCF) tests on $Ni_{54}Ti_{45}Hf_1$ and $Ni_{54}Ti_{43}Hf_3$ alloy specimens
- TEM characterization of microstructure evolution in 56at.% Ni alloys
- Continued Time/Temperature/Transformation (TTT) research

Metrics		
Description	**% Complete**	**Status**
1. Residual stress and hardness testing on $Ni_{55}Ti_{45}$ & $Ni_{54}Ti_{45}Hf_1$ (NASA)	80%	●
2. Literature review	80%	●
3. Rolling contact fatigue characterization of $Ni_{54}Ti_{45}Hf_1$ alloy	70%	●
4. Time/Temperature/Transformation of $Ni_{54}Ti_{45}Hf_1$ alloy	30%	●
5. Alloy optimization – vary nickel and hafnium contents by 1-8 at%	20%	●