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# Orientation Dependent Compression Behavior of $Co_{35}Ni_{35}Al_{30}$ Single Crystals

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## Abstract

The shape memory effect (SME) and superelasticity (SE) behavior of homogenized $Co_{35}Ni_{35}Al_{30}$ single crystals were systematically characterized along the [100], [110] and [111] orientations under compression. The shape memory behavior of CoNiAl was found to be highly orientation and stress/temperature dependent. Maximum compressive recoverable strains were 3.98 % in [110], 3 % in [100] and 0.30 % in [111] orientations, respectively. The $Co_{35}Ni_{35}Al_{30}$ demonstrated a very high superelastic temperature window of more than 350 °C along the [100] and [110] orientations. Moreover, two-way shape memory effect with very low thermal hysteresis of about 6 °C was observed along the [110] orientation. The large decrease of recoverable strain and hysteresis with stress (or temperature) was mainly attributed to the difference of elastic moduli of transforming phases.

***Keywords:*** Shape memory alloys; CoNiAl; Single crystal; Two-way shape memory effect; superelasticity

## 1. Introduction

The magnetic shape memory alloys (MSMAs) received considerable attention since they have the ability to show large reversible magnetic field-induced strains (MFIS) [1, 2]. There are two main mechanism for reversible shape change: variant reorientation as in NiMnGa alloys or phase transformation as in NiMnCoIn alloys [3-5]. Although NiMnGa Heusler alloys can achieve high MFIS with low magnetic field, their extreme brittleness restricts their envisioned applications as magneto-actuators, sensors, caloric materials or energy harvesters. CoNiGa [6-9] and CoNiAl [10-12] alloys were developed as an alternative MSMA and they demonstrated high strength, stable behavior, low stress for variant reorientation, ability to alter transformation temperatures with heat treatments and high resistance to oxidation. The ductility of Co-based alloys were found to be improved mainly due to the existence of γ-phase (disordered fcc A1) [13]. The stress required for the onset dislocation slip of CoNiAl has been reported around 1100