ESRF	Experiment title: Understanding the magnetocaloric effect in Mn-rich Mn-Ni-Sn-(Co) Heusler alloys	**Experiment number**: MA-3446
Beamline:	**Date of experiment**: from: 10.05.17 to: 16.05.17	**Date of report**:
Shifts: 18	**Local contact(s)**: Mauro Rovezzi	*Received at ESRF:*
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Report:

In this proposal we aim to determine the local electronic and geometric lattice structure of ternary and quaternary Mn-rich Heusler alloys Mn-Ni-Sn(Co) and their dynamic behaviour through their magnetostructural phase transition using EXAFS with the setup provided at BM30b.

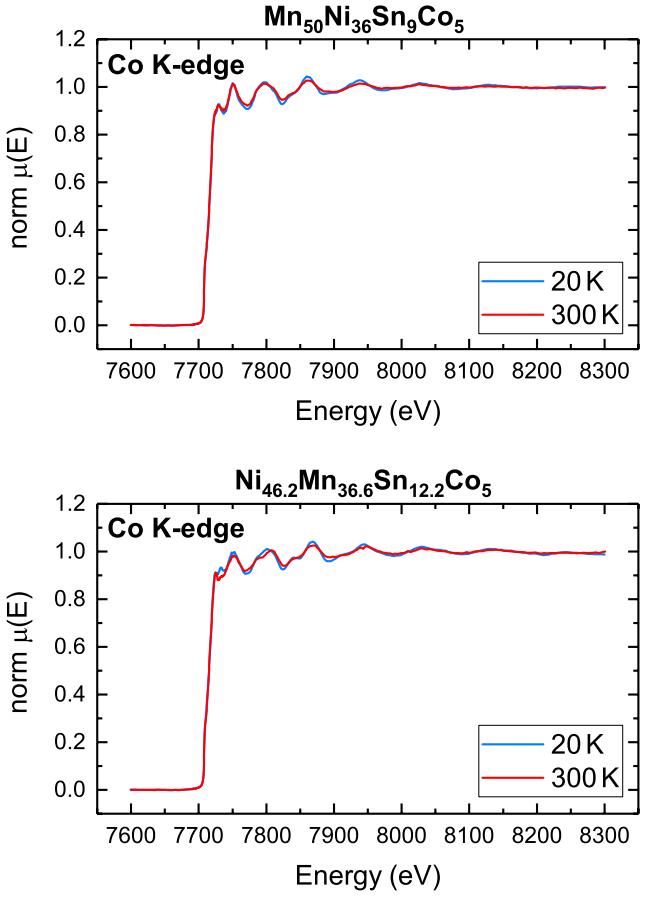

Figure 1: normalized x-ray absorption at the Co K-edge at 20 K and 200 K for an Mn-rich (top) and Ni-rich (bottom) compound.

During the beamtime we studied 5 different samples which differed in the stoichiometry for Sn and Co and therefore exhibit different transition temperatures from a Martensite to an Austenite phase. Focus for the temperature-dependent behaviour was put on two Co containing Mn-rich compounds. We studied the temperature dependent EXAFS at the Mn, Co and Ni K-edges of samples with the following stoichiometries: $Mn_{50}Ni_{40}Sn_{10}$, $Mn_{50}Ni_{36.5}Sn_{8.5}Co_5$ and $Mn_{50}Ni_{36}Sn_9Co_5$ together with two Ni-rich reference samples with the composition $Ni_{50.8}Mn_{34.6}Sn_{14.6}$ and $Ni_{46.2}Mn_{36.6}Sn_{12.2}Co_5$. Despite the addition of only one atomic percent of Sn, the transition temperature from the low magnetic Martensite phase at low temperatures, to a high magnetic Austenite phase at high temperatures can be shifted by about 250K. Co additionally drives the magnetization and modifies the transition tmeperature. The aim was to clarify the local structure and possible

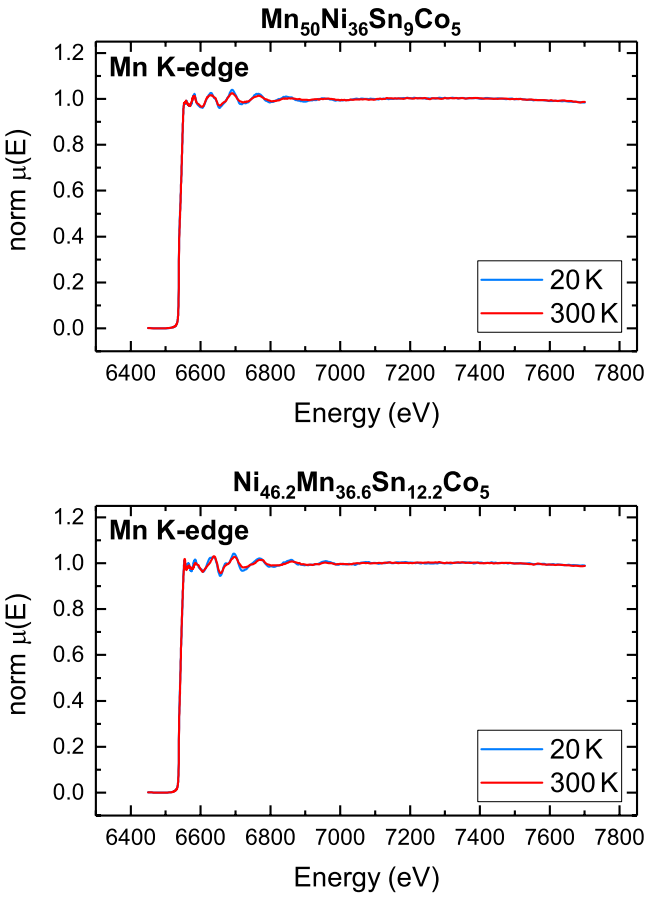

Figure 2: normalized x-ray absorption at the Mn K-edge at 20 K and 200 K for an Mn-rich (top) and Ni-rich (bottom) compound.

disorder as well as the role of Co on the stability of the compounds and the lattice dynamics across the phase transition for the Mn-rich alloys. All of the samples have been measured in their low magnetic Martensite and high magnetic Austenite phase at 20 K and 300 K. The samples $Mn_{50}Ni_{36}Sn_9Co_5$ and $Mn_{50}Ni_{40}Sn_{10}$ have furthermore been measured across their magnetostructural phase transition from low to high temperatures and back with 16 temperature points for the first and 15 points for the second sample listed to evaluate the dynmic behaviour through the transition. Figure 1 shows exemplarily the normalized x-ray absorption at the Co K-edge at 20 K and 300 K for a Mn-rich ($Mn_{50}Ni_{36}Sn_9Co_5$) and a Ni-rich compound ($Ni_{46.2}Mn_{36.6}Sn_{12.2}Co_5$) in comparison. The change in temperature and in the structural phase can be seen as they are reflected in the spectral shape of the absorption and thus correspond to changes in the local environmet of Co after undergoing the magnetostructural phase transition. Figure 2 shows the Mn K-edge of the same samples. The change from the Martensite to Austenite Phase is not as pronounced but still points towards a change in local environment as the spectral shape differs with temperature. The EXAFS spectra through the transition for sample $Mn_{50}Ni_{36}Sn_9Co_5$ and $Mn_{50}Ni_{40}Sn_{10}$ have been measured at temperature points corresponding to the expected transition temperatures obtained by SQUID magnetometry.