XAS study of Co1-xAlx (x > 0.50) nanoparticles and structural change upon oxidation

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The main goal of this study of Co1-xAlx nanoparticles is to determine the composition and oxidation conditions which will lead to the formation of Co@Al2O3 nanoparticles, Such segregated nanoparticules should exhibit both strong magnetic moment (actually higher than bulk Cobalt) and good stability vs. exposure to air.

Small (< 3 nm) particles have actually been synthesized and structurally and magnetically characterized by Wide Angle X-ray scattering (WAXS) and SQuID (Figure 1) and indeed evidence the formation of well-defined alloys with the expected magnetic properties, especially the dramatic enhancement of the magnetic moment related to the partial oxidation of the alloy.

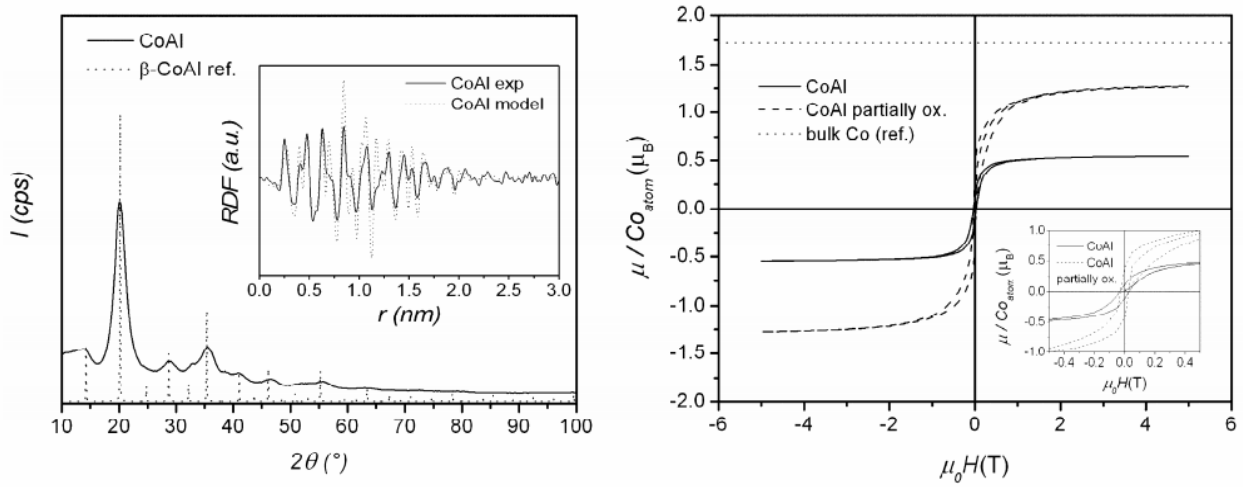

Figure1: Left, WAXS pattern of βCo1Al1 nanoparticles and the radial distribution function (shown as inset) and right, SQuID measurement at 2K on βCo1Al1 particles (solid curve) and oxidized CoAl particles (dashed curve).The hysteretic behaviour of both samples is shown in the inset..

EXAFS and XANES measurements have been performed on the E4 beamline in transmission mode at room temperature on samples for different Co/Al ratios and different oxidation levels. Because of the high sensitivity to oxidation of the alloys before complete passivation by the Al2O3 layer, the protocol successfully developed for even more sensitive FeRh and CoRh nanoparticules was applied. However fewer than expected successful measurements could be obtained and are still under analysis.

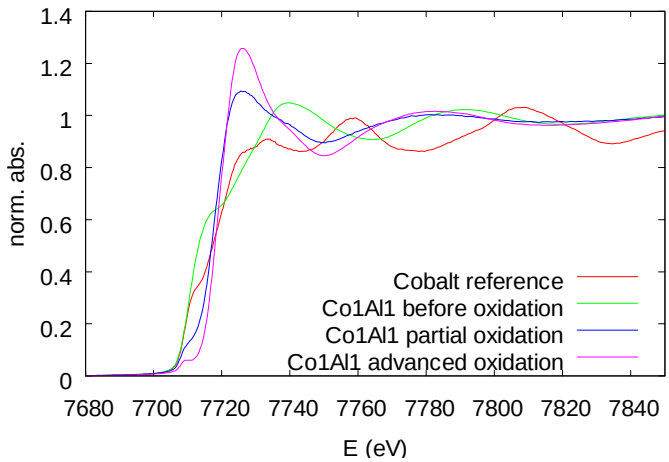

Figure 2: Normalized absorption of the Co1Al1 nanoalloy at different levels of oxidation.