High Temperature Oxidation in the System Co-Ga studied by *in situ* XRD, XAS and TG

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The kinetics of high temperature oxidation in the system Co-Ga was studied by X-ray diffraction (XRD), X-ray absorption spectroscopy (XAS) and thermogravimetry (TG). All three techniques were used under in situ conditions, i.e. at elevated temperatures and defined oxygen partial pressures. In this way the solid state oxidation reactions could be followed *in situ* and time resolved.

Oxidation of cobalt was studied at temperatures between 600 and 800°C in atmospheres of different oxygen partial pressures by *in situ* XRD (Fig.1) Starting with a compact and planar cobalt sample either a single oxide scale consisting of the monoxide, CoO, or two scales consisting of monoxide and spinel, Co_3O_4, were found, depending on the external oxygen partial pressure. After an induction period, growth of the oxide scales can be described by parabolic rate laws, and parabolic rate constants were derived as a function of temperature and oxygen partial pressure. Oxidation of cobalt in air was also studied by means of Quick X-ray Absorption Spectroscopy (QEXAFS) at the Co-K-edge. Using this technique, a complete X-ray absorption spectrum can be taken within some seconds [1]. By deconvolution of the spectra the fractions of Co, CoO and Co_3O_4 were determined as a function of time (Fig.2). The overall oxidation reaction can be described by a three-step mechanism in which cobalt monoxide, CoO, is formed intermediately.

Oxidation of the intermetallic compound CoGa in air at temperatures between 800 and 1000°C results in the formation of a dense oxide scale consisting only of β-Ga_2O_3. Parabolic rate constants were obtained by in situ XRD and thermogravimetry and are discussed in terms of possible transport mechanisms. The pore structure observed at the interface CoGa/Ga_2O_3 [2, 3] is explained in terms of a supersaturation of defects in the intermetallic CoGa which is due to the selective oxidation of Ga.

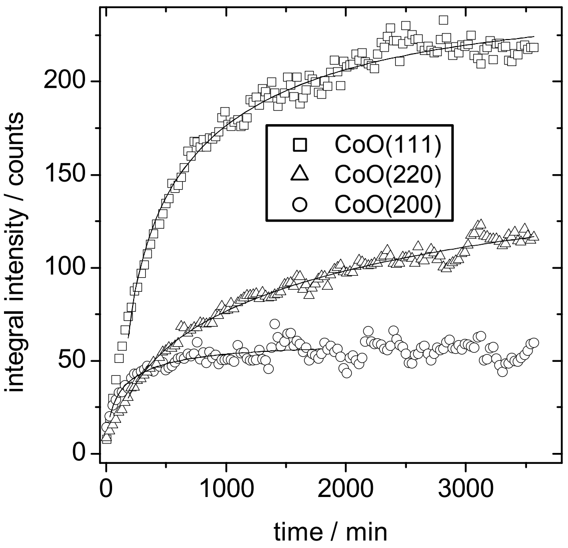

Fig.1 Integral intensities of three CoO reflections during the oxidation of Co at 800°C at $p(O_2)=4.6\cdot10^{-13}$ bar as function of time.

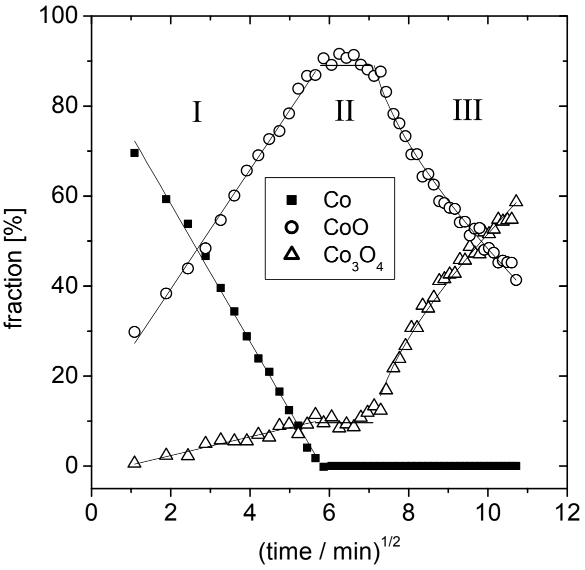

Fig.2 Fractions of Co, CoO and Co_3O_4 during the oxidation of Co at 700°C in air as function of time.

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References

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