

## X-ray photoelectron spectra and Auger studies of the surface oxidation of cobalt<sup>†</sup>

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**Abstract.** Surface oxidation of Co has been investigated at different temperatures in the 300–600 K range at oxygen exposures upto  $10^6$  L by XPES and AES techniques. In the XPES, both the valence band and core level bands have been employed to monitor the oxidation while in the AES, metal Auger intensity ratios as well as O(KLL)/Co(L<sub>23</sub>M<sub>45</sub>M<sub>46</sub>) ratios have been examined. Only CoO is formed on the surface at high oxygen exposures at and above 500 K.

**Keywords.** X-ray photoelectron spectroscopy; Auger electron spectroscopy; surface oxidation; Auger ratio; oxidation state.

### 1. Introduction

X-ray photoelectron spectra (XPES) of CoO and Co<sub>3</sub>O<sub>4</sub> have shown the characteristic features of these oxides in the valence bands and core levels (Rao *et al* 1979; Haber and Ungier 1977, Oku and Hirokawa 1976; Bonnelle *et al* 1975). Thus, the  $2p_{3/2}$  binding energy of Co<sup>2+</sup> in CoO is 780.5 eV while that of Co<sup>3+</sup> in Co<sub>3</sub>O<sub>4</sub> is 779.5 eV. CoO shows a strong satellite around 6.3 eV after the  $2p_{3/2}$  band whereas in Co<sub>3</sub>O<sub>4</sub> a weak satellite is observed around 9 eV. Surface oxidation of Co has been investigated by Moyes and Roberts (1977), Chuang *et al* (1976) and Brundle *et al* (1976) mainly to determine the nature of the oxide formed on the surface at 300 K. We have carried out a systematic study of the surface oxidation of cobalt at 300, 400, 500 and 600 K by employing the valence band and core levels of Co as well as the oxygen (1s) band in the x-ray photoelectron spectra. We have also followed the surface oxidation by a novel technique recently proposed by Rao *et al* (1980) wherein the cobalt Auger line intensity ratios are employed to monitor the oxidation.

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