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A study of the Al–Co–Cr alloy system

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Abstract

The Al–Co–Cr alloy system was studied by scanning and transmission electron microscopy, powder X-ray diffraction and differential thermal analysis. Partial isothermal sections of Al–Co–Cr were determined at 1150, 1100, 1000, 900, 800 and 700 °C. The region of the β_{Co}-phase extends towards γ_{Cr} up to ~18.5 at.% Cr and ~57 at.% Al. The solubility of Cr in H_{Co}, M_{Co} and Al_9Co_2 reaches ~11.0, 6.0 and 1.5 at.%, respectively, while θ_{Cr}-phase, μ_{Cr} and γ_{Cr} dissolve up to ~3.0, 1.0 and 6.0 at.% Co, respectively. The η_{Cr} phase extends up to ~$Al_{74.5}Co_4Cr_{21.5}$. No ternary phases were revealed in Al–Co–Cr at 1100-1150 °C. Five ternary phases designated ζ_1, O_1, ν, ϕ and π were revealed. The ϕ-phase ($P2_1$ or $P2_1/m$, $a \approx 1.35$, $b \approx 1.27$, $c \approx 1.45$ nm, $\beta \approx 100°$) is formed between ~$Al_{70.5}Co_{8.0}Cr_{21.5}$ and $Al_{77.0}Co_{7.5}Cr_{15.5}$. The π-phase (*C*-center monocl., $a \approx 3.28$, $b \approx 1.24$, $c \approx 2.43$ nm, $\beta \approx 108°$) is formed between ~$Al_{75.0}Co_{11.5}Cr_{13.5}$ and $Al_{79.0}Co_{11.5}Cr_{9.5}$. The O_1-phase (*B*-center orth., $a \approx 3.318$, $b \approx 1.255$, $c \approx 2.412$ nm) is formed in a small region around ~ $Al_{72.5}Co_{5.0}Cr_{22.5}$. The ν-phase ($P6_3/m$, a = 4.0630, c = 1.2496 nm) is formed between ~$Al_{75.5}Co_{5.5}Cr_{19}$ and $Al_{81}Co_{5.0}Cr_{14}$. The ζ_1-phase ($R\bar{3}$ *or* $R3$, $a \approx 1.75$, $c \approx 8.0$ nm) is formed in a small region around ~$Al_{80.5}Co_{3.5}Cr_{16.0}$.

Keywords: Transition metal alloys and compounds; Phase diagrams; Al–Co–Cr; Al–Co.

1. Introduction

Due to practical interest, the Al–Co–Cr alloy phase diagram was only studied at low-Al compositions. The earlier results have been reviewed in Refs. [1, 2]. Four partial isothermal sections below ~55 at.% Al were determined in the more recent Ref. [3] using the diffusion

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