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Residual stress in polycrystalline thin Cr films deposited on fused silica substrates

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Abstract content
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The Néel temperature (T_N) in thin film Cr coatings is strongly influenced by dimensionality effects, as well as strain and stress [1]. In an investigation of Cr thin films with thickness (t) varied between 20 and 320 nm deposited on fused silica substrates, the T_N values obtained from resistivity measurements indicate an increase with thickness as expected [1]. However, it is noted that the T_N ≈ 460 K obtained for the t = 320 nm sample, is considerably higher than the transition temperature of 311 K obtained in bulk pure Cr. This behavior is unexpected, but incidentally corresponds with T_N = 475 K obtained for the CSDW-P Néel transition in bulk Cr when influenced by stresses introduced by cold working [3,4]. Since stresses are well known to influence the physical properties of materials [1,2], amongst others the magnetic properties, this study is now extended to investigations of the in-plane stresses in these thin films. This is done using the specialised X-ray diffraction sin²&psi–method [2,5,6]. With this technique, variations in the lattice plane spacing is accurately determined from the precisely measured (310) Bragg peak position as function of systematically increased tilt angles, &psi, from the surface normal to as close as achievable to the in-plane direction. The in-plane residual strain present in the coating (&epsilon) is determined from the slope of a linear plot through the fractional change in the plane spacing (or Bragg peak position) versus sin²&psi plots. Residual stress (&sigma) are calculated from the &epsilon versus sin²&psi data by incorporating the elastic properties of the coating material. The results indicate tensile stresses in all the samples. Results will be used to correlate the T_N values to the stresses in the coatings.

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