

Surface-induced resistivity of CoSi₂ films and violations of Mathiessen's rule

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We analysed the residual resistivity data for more than 40 films of CoSi₂ reported by different groups using the available quantum theories of size effects in metal films. We found that the predictions of the model of Trivedi and Ashcroft (1988 Phys. Rev. B 38 12298) of Tesanovic et al (1986 Phys. Rev. Lett. 57 2760), and of the mSXW theory (Munoz et al 1999 J. Phys. Condens. Matter 11 L299) agree roughly with the data and with each other over the entire range of thickness $10 \text{ nm} < t < 110 \text{ nm}$, although the rms roughness amplitude needed to best describe the residual resistivity data is somewhat different for each model. All three models predict surprisingly similar values for the film resistivity ρ_F and for the surface resistivity ρ_S arising from electron-surface scattering. All three models indicate that Mathiessen's rule is violated in thin CoSi₂ films, that is, $\rho_F > \rho_S + \rho_B$ where ρ_B is the bulk resistivity. For $110 \text{ nm} > t > 10 \text{ nm}$, the resistivity of the film exceeds by some 25-55% the