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Semiconductor behavior in bcc $Cr_{1-x}Al_x$ thin films[1] Z. BOEKELHEIDE, F. HELLMAN, University of California, Berkeley — $Cr_{1-x}Al_x$, with x = 0.15-0.25, has semiconducting electronic properties: extremely high resistivity and a negative temperature coefficient of resistance, along with a gap in the infrared reflectivity. This is unusual for an alloy of two metals, but similar behavior has been observed in Fe_2VAl and has been attributed to a hybridization-induced band gap. In bulk, $Cr_{1-x}Al_x$ is known to be inhomogeneous, with two crystal phases coexisting: one, a disordered bcc solid solution, and the other, called the "X-phase", with a microstructure consisting of 1-3nm domains. Because of this inhomogeneity, it was previously not known which phase was responsible for the semiconducting behavior. We used epitaxial thin film growth techniques to preferentially nucleate the bcc phase and study the effect of crystal structure on the electronic properties. We found that films grown epitaxially on MgO (100) substrates, expected to grow preferentially in the bcc phase, have high resistivity like bulk $Cr_{1-x}Al_x$, while polycrystalline films grown on amorphous SiO_2 have lower resistivity. This suggests that the semiconducting behavior is intrinsic to the bcc structure.

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