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Autor(en): **Henz, J. / Hugi, J. / Onda, N.**

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ELECTRICAL MEASUREMENTS ON ULTRA-THIN $COSI_2$/SI HETEROSTRUCTURES

J. Henz, J. Hugi, N. Onda, H. von Känel, Laboratorium für Festkörperphysik, ETH-Hönggerberg, CH-8093 Zürich, Switzerland

Abstract: The parallel electric transport in ultra-thin (50Å - 10Å) epitaxial $CoSi_2$ layers on Si(111) has been investigated. We compare the resistivity of buried films, i.e. with 50Å epitaxial Si on top, versus that of surface layers. The buried films show lower resistivity, which can be explained by a sharper upper interface leading to reduced intersubband scattering.

1. Introduction:

$CoSi_2$ has the cubic CaF_2 structure with 1.2% lattice mismatch to Si. Using coevaporation of Si and Co [1] we have grown a series of $CoSi_2$ films on Si(111) with thicknesses in the range from 10Å to 50Å. In addition we have grown a 50Å thick epitaxial Si layer on one half of all samples. Thus for each $CoSi_2$ thickness we have obtained two different specimens, one without and one with Si on top. By this method we could compare the influence of the surface on the electrical properties of the films.

2. Electric Measurement:

To measure the resistivity we used a six legged bridge, which was defined by mesa-etching, enabling a four point measurement. The temperature dependence of the resistivity $\rho(T)$ showed in every case metallic behavior. In fig. 1) are shown two typical measurements obtained on a 44Å thick film. The slope of the linear part of $\rho(T)$ is the same with and without Si coverage and it is almost constant down to a layer thickness of 25Å. For the thinnest layers it rises to much higher values in contradiction to [2]. However, the most striking finding is certainly the considerable lowering of the residual resistivity ρ_0 for layers with Si on top (fig. 1). This has been seen for the first time and is in contradiction to results obtained on films grown by solid phase epitaxy [3]. We have to stress that the ρ_0's are the lowest ever reported for all thicknesses. We therefore conclude, that the quality of the

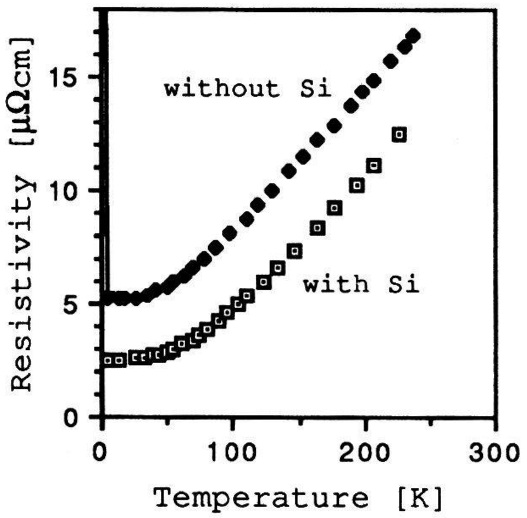

Fig. 1): ρ(T) of a 44Å thick $CoSi_2$ layer with and without 50Å Si on top.

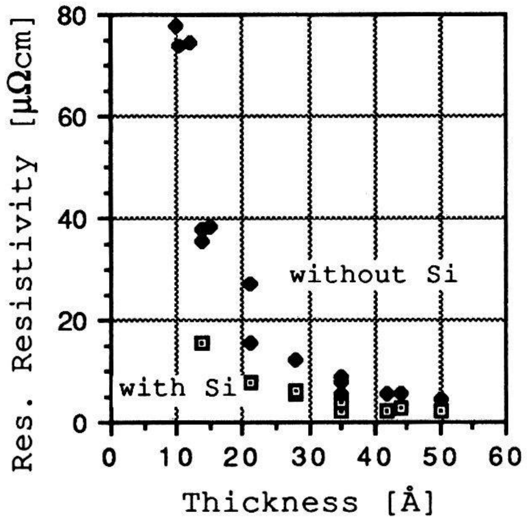

Fig. 2): The residual resistivity in function of the layer thickness.

samples is excellent. In fig. 2) we show the dependence of ρ_0 on layer thickness for the two kinds of samples. We observe that the thinner the samples, the larger the influence of the Si-layer.There are no differences in the carrier density, as Hall measurements indicate, which would explain this behavior. The increase of the resistivity with decreasing $CoSi_2$ layer thickness can partly be explained by microscopic surface roughness [4]. The lowering of the resistivity with Si on top is due to a sharper upper interface in accordance with TEM results.

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