Studies of Thin Metal Silicides on Silicon (111)

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Abstract

This work describes the study of RE/Si(111) (RE – rare earth) and Fe/Si(111) surfaces by means of medium energy ion scattering (MEIS), scanning tunnelling microscopy (STM) and scanning tunnelling spectroscopy (STS).

The Tm/Si(111) surface has been studied by means of MEIS. Data has been obtained from the 1 × 1 surface reconstruction formed at monolayer rare earth coverage. The data have been compared to simulations for a model based on the known structures of other RE silicides. The structure of the Tm silicide formed has been seen to fall into this class of structure. This investigation has led to a re-evaluation of the determination of the structural parameters for this model. A trend in the structural parameters has been revealed across the rare earth series.

The electronic structure of the rare earth silicide surface has been investigated. STS has been performed on the Ho silicide 1 × 1 surface. A lack of distinction between inequivalent sites has been observed and the data found to be in broad agreement with what is known of the electronic structure of these RE silicides.

A MEIS investigation has been made of the initial growth of Fe on the Si(111) 7 × 7 surface. Two phases have been found to form depending on anneal temperature. At anneal temperatures of around 300 ˚C a 1 × 1 phase is formed and at higher anneal temperatures a 2 × 2 phase is found. Data have been obtained from three scattering geometries. The data indicate that both phases are structurally very similar. A CsCl-type structural model is proposed, the 2 × 2 phase being formed by a Si adatom overlayer.

The use of the RE silicide as a growth template has also been briefly investigated by MEIS. The deposition of Fe onto the Ho silicide surface has been found to disrupt the structure and progressive annealing failed to reorder the system.

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Declaration

The work presented in this thesis is that of the author except where the contributions of others have been acknowledged explicitly in the text or by means of references. No part of this work has been presented for any other qualification at this or at any other university.

Publications

Growth and electronic structure of holmium silicides by STM and STS, E.W. Perkins, I. M. Scott and S. P. Tear, *Surface Science* **578** 80 (2005)