Probing nanoscale thin films by phase sensitive neutron reflectometry: a simulation study

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Abstract: Neutron reflectometry is a powerful tool for research in nanostructure materials. It is a powerful technique for investigating surfaces and interfaces, thin films, nanostructure materials, biomembranes and magnetic films. Here, by a simulation model, we show that how it can be used to probe the nano material thin films. It is shown that by knowing the information of the complex reflection coefficient, the data analysing of neutron reflectivity leads to find the components of any thin film and their thicknesses.

Keywords: neutron reflectometry; nano thin films; scattering length density; phase problem.

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Biographical notes: Seyed Farhad Masoudi is the Assistant Professor of K.N. Toosi University of Technology in Tehran, Iran. He hold his PhD in physics from University of Tehran, and MSc from Sharif University of technology. During PhD era he worked on neutron optics and its application in condensed matter especially in nano material thin films. He also works on numerical methods in physics like finding the plasma sheath dynamics.

1 Introduction

The specular reflection of cold neutrons from thin films is a powerful tool to probe the physics of these samples [1]. The reflectivity of neutrons, in general, depends on the neutron wave number in depth direction $q = 2\pi\sin\theta/\lambda$ (where λ is the neutron wavelength and θ is the reflection angle) and the microstructures of the sample. Thus, in neutron specular reflection experiments, the reflectivity profile $R(q)$ of a flat sample is measured as a function of the momentum transfer to obtain the information about the atomic or magnetic density depth profile of the sample [2]. Figure 1 shows the sketch of a new facility for neutron reflectometry situated at the Swiss Spallation Neutron Source SINQ [3].