Available online at www.sciencedirect.com
SCIENCE DIRECT®
Physica B 362 (2005) 153–157
PHYSICA B
www.elsevier.com/locate/physb

# Phase determination in spin-polarized neutron specular reflectometry by using a magnetic substrate

S. Farhad Masoudi*, Ali Pazirandeh

*Physics Department, University of Tehran, P.O. Box 1943-19395, Tehran, Iran*

Received 2 December 2004; received in revised form 4 February 2005; accepted 4 February 2005

**Abstract**

The scattering length density profile for a thin film structure can be determined uniquely if both the modulus and phase of the reflection coefficient is known. Here, we describe a method for recovering the phase information which utilize a magnetic substrate and based on polarization analysis of the reflected beam. The method is derived in the formalism of transfer matrix so it is applicable for any unknown real scattering length density of nonmagnetic films (i.e. in the case where there is no effective absorption).


*PACS:* 61.12.Ha; 28.20.−v

*Keywords:* Neutron specular reflection; Phase problem; Reference layer Magnetic substrate

## 1. Introduction

Neutron specular reflectometry has become a suitable technique for investigation of the physics of many surface and interfacial structures [1,2]. The measurement of the specularly reflected intensity in term of the wave number $q$ perpendicular to the sample surface provides important information on the atomic or magnetic scattering length density (SLD) profile of the nanostructure materials along their depth $x$ [3]. However, extracting the profile from the measured reflectivity $R(q)$, as a function of $q$, has been hampered by the so-called phase problem [4,5]. This problem refers to the loss of the phase of reflection coefficient in any scattering problem. In the absence of the phase, least-squares-fit methods allow the determination of the depth profile [6,7] but in general, the solution is not unique since different profiles may produce the same reflectivity [8,9]. If the reflection coefficient is known in modulus and phase, it can be inverted for the depth profile in a fairly straightforward way, by solving the Gelfand–Levitan–Marchenko integral equation or practical algorithms have been

*Corresponding author. Tel.: +98 9123791307; fax: +98 218004781.
*E-mail address:* fmasoodi@chamran.ut.ac.ir (S. Farhad Masoudi).

0921-4526/$ - see front matter © 2005 Elsevier B.V. All rights reserved.
doi:10.1016/j.physb.2005.02.005