REFLECTOMETRY WITH NUCLEAR REACTIONS AND NEUTRON SPIN FLIP IN NEUTRON WAVE

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Nowadays investigation of proximity effects at the interface between two media are in focus of view [1-5]. In particular it relates to the interface between superconductor and ferromagnet. Due to the mutual influence of ferromagnetism and superconductivity, because of the finite values of the coherence lengths, a significant modification of the magnetic and superconducting properties occurs. It appears, in particular, as changing of magnetization's spatial distribution. It is important to establish the correspondence of the magnetic spatial profile (spatial dependence of magnetization) to the nuclear spatial profiles of the elements of the contacting media. To determine the spatial magnetic profile, the standard method of reflectometry of polarized neutrons is used, which makes it possible to determine the energy of the potential interaction of a neutron with a medium. At the interface between two media, the interaction potential is the sum of the interaction potentials of elements penetrating each other. Standard neutron reflectometry does not make it possible to establish which elements are associated with changes in the interaction potential and, in particular, in the magnetic profile. To determine the profile of the interaction potential of a neutron with individual elements, it is necessary to register the secondary radiation of the elements.
At the moment, channels for recording charged particles [6], gamma quanta and spin-flip neutrons [7] have been realized at the REMUR spectrometer of IBR-2 reactor in Dubna. Several tens of isotopes and magnetic elements are available for measurements. For the layer with thickness 5 nm: a) for the charged particles registration channel, the minimum value of the cross section is σ_{min}=0.025 barn, the cross section $\sigma>\sigma_{min}$ has 22 isotopes; b) for the gamma-quanta registration channel, σ_{min}=0.3 barn, more than 100 isotopes have a cross section σ>0.3 barn; c) for the polarized neutrons registration channel, the minimum, perpendicular to the neutron polarization, component is 1 G.

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