Ferromagnetic resonance in exchange-related ferromagnet-paramagnet multilayer structures

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Multilayer metallic magnetic structures attract great interest in recent years. One of the most important characteristics of such systems is the interlayer exchange interaction between magnetic layers Those interaction determines properties of devices which can be made on the basis of multilayer magnetic structures (magnetic sensors, memory elements and etc.). For many applications it is important that the volue of the interaction between the layers was not fixed and had the opportunity to control. Therefore, of particular interest is to study of the interlayer interaction in F/f/F systems, where F is a "strong" ferromagnet with a Curie temperature significantly higher than room temperature (T_F>500 K), f is a weak ferromagnet, for which the Curie temperature T_f <T_F and close to the room temperature T. The interest for such structures due to possibility of uses one as "magnetic" refrigerators. |The principle of work such magnetic refrigerators is based on the magnetocaloric effect [1, 2].

We investigated a series of F/f/F multilayer structures $Ni_{80}Fe_{20}/Ni_{65}Cu_{35}/Co_{60}Fe_{40}$ with thicknesses of $Ni_{65}Cu_{35}$ layer in the range of 6-22 nm by method of ferromagnetic resonance in the temperature range 77-300 K. It was found that interaction between the Ni_{80}Fe20 films and $Co_{60}Fe_{40}$ is ferromagnetic nature for thicknesses of $Ni_{65}Cu_{35}$ less than 15 nm; for the thickness of 20 nm interaction change the sign depending on the temperature and can be ferromagnetic or antiferromagnetic type. It was used the phenomenological theory of phase transitions Landau for an accurate description of the experimental results. It was identified collinear and noncollinear magnetic state for different temperatures which depend on the external magnetic field and thickness of layer $Ni_{65}Cu_{35}$. The financial support of the Russian Science Foundation (Grant No. 16-12-10254) is gratefully acknowledged.

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