



## Physics Applied to Biological Systems: Theory and Experiments for a Gene Therapy Model

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## **Roughness Influence on the Exchange Bias Effect in Trilayers of NiFe/FeMn/NiFe (abstract)**

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Magnetic thin films are the start point for the development of new devices for magnetic recording and storage. The search for materials with desirable features leads to a large amount of new systems but most of the physics underlying those effects still needs to be understood. One of the most important parameters is the spins configuration at the interfaces, which can be accomplished by the determination of the values of the orbital and spin magnetic moments.

The Thin Film Laboratory of CBPF/MCT-RJ is currently producing, with a magnetron sputtering system, magnetic thin films and multilayers systems that display GMR, exchange bias effect, and spin-valves. Here we report on the influence of the roughness on the exchange bias effect in trilayers of Py/FeMn/Py (Py = Ni<sub>81</sub>Fe<sub>19</sub>), deposited under an applied magnetic field of 4600e on Si<110> substrate by dc magnetron sputtering, in the Thin Films Laboratory of CBPF/MCT-RJ. Trilayers were prepared under different air pressures (2, 5 and 10 mbar) in order to produce distinct layer roughness.

X-ray diffraction shows that FeMn grows in the g phase, which is essential for the occurrence of exchange bias in the Py/FeMn system. Reflectivity experiments suggest that the layer roughness increases with working pressure. XMCD experiments were performed at the D08A-SGM beamline of LNLS, Brazilian synchrotron facility. A dichroism at the Mn-L<sub>2,3</sub> edges and a reduction of the Fe and Ni spin magnetic moments were observed in the Py/FeMn interface.

Samples were prepared with a <sup>57</sup>Fe thin layer at the interface to serve as a probe for conversion electron Mössbauer spectroscopy (CEMS) measurements, at 300°K. The Mössbauer spectra have basically two components: a slightly broadened sextet, with the Ni<sub>81</sub>Fe<sub>19</sub> hyperfine parameters, and a broad paramagnetic subspectrum resulting from the g-FeMn phase from the spacer layer and from an alloy formed by NiFe and FeMn interdiffusion process.

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## **Physics Applied to Biological Systems: Theory and Experiments for a Gene Therapy Model (abstract)**

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Efficient transfection of eukaryotic cells is an essential step of optimizing gene expression for genetic therapy and for stimulating the immune response induced by the DNA vaccination. The DNA topology and the vehicle used to deliver it are the two aspects explored in this work. A plasmid expressing the  $\beta$ -galactosidase enzyme was used to transfect Vero cells in order to evaluate liposome-mediated transfection of circular and linear DNA. The results showed a low efficiency of linear DNA:liposome complexes in transfecting the cells, probably due to an impaired association between the two components. Atomic force microscopy has confirmed the difference in the complex size: circular topology leads to larger complexes than the linear one. Based on an analytic theory, low concentrations of amphiphilic molecules were used to neutralize the linearized plasmid. We were able to obtain an increased transgene expression without the toxicity observed with the usual linear DNA liposome delivery methods.