

## Surface Spin-Valve with an Exchange Bias

L. Tryputen<sup>a</sup>, V. Fisun<sup>a</sup>, O. Balkashin<sup>a</sup>, Yu. Naidyuk<sup>a</sup>, I. Yanson<sup>a</sup>, S. Andersson<sup>b</sup>, V. Korenivski<sup>b</sup>, Yu. Yanson<sup>c</sup>, and H. Zabel<sup>c</sup>

<sup>a</sup>Verkin Institute for Low Temperature Physics and Engineering, NASU, Kharkov, Ukraine

<sup>b</sup>Nanostructure Physics, Royal Institute of Technology, Stockholm, Sweden

<sup>c</sup>Lehrstuhl für Experimentalphysik/Festkörperphysik, Ruhr-Universität Bochum, Bochum, Germany

Magnetoresistance  $R(H)$  at  $V=0$  and differential resistance  $R(V)$  ( $R=dV/dI$ ) at  $H=0$  of point contacts between nonmagnetic Cu tips and single ferromagnetic films (FM - Co) exchange-pinned by antiferromagnetic layers (AFM - Fe<sub>50</sub>Mn<sub>50</sub>) have been investigated. Analysis of measured  $R(V)$  and  $R(H)$  characteristics confirms recently proposed model of the point contact surface spin-valve (SSV).<sup>1</sup> Magnetoresistance  $R(H)$  of SSV in the point contacts to ferromagnetic films exchange-pinned by antiferromagnets shows an exchange offset that depends on a mutual orientation of the applied magnetic field in respect to a pinned magnetization of the AFM/FM layer. We have found that switching of this ferromagnet bulk occurs at lower fields than switching of surface spin layer. In addition, it has been shown that point contact SSVs based on an amorphous alloy Co<sub>40</sub>Fe<sub>40</sub>B<sub>20</sub> (3,6,9,20 nm) also have the same properties as spin-valves with a geometrically controlled structure. The experiments showed that an increase of an exchange bias under decreasing of CoFeB films thickness is observed both at the surface and in the SSV bulk. A negative magnetoresistance of some point-contact SSVs based on CoFeB was also observed.

<sup>1</sup>I.K. Yanson, et al Nano Lett. **7**, 927 (2007).