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Requirements for hydrogen absorption experiments with RNR in Pd/Co/Pd

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Pt/Co/Pt and Pd/Co/Pd heterostructures with perpendicular magnetic anisotropy (PMA) are traditionally used for magnetic recording. PMA can be tuned by e.g. thin film thickness, strain, ion bombardment or temperature. Recently, it has been shown that the absorption of hydrogen in the heavy metal modifies the interfacial spin-orbit coupling and hence reduces the PMA.[1-3] As a result, reversible and non-destructive toggling of the easy axis of magnetization between in-plane and out-of-plane orientation at room temperature was demonstrated in a Co/GdO_x all-solid-state device for magnetic hydrogen sensing.[4]

Resonance enhanced polarized neutron reflectometry (RNR) is an effective tool for studying the hydrogen uptake quantitatively and with time resolution of less than seconds and the hydrogen impact on the magnetic properties in PMA systems.[5]

In this contribution we report on results of RNR experiments on hydrogen uptake in Pt/Co/Pt trilayers sandwiched by 25 nm Nb layers on MgO(001) substrates fabricated by molecular beam epitaxy measured at D17 at ILL and the requirements to measure the switching of the easy axis on hydrogen uptake in the trilayer systems Pt/Co/Pt and Pd/Co/Pd.

[1] S. M. Valvidares, et al., Phys. Rev. B 81, 024415 (2010)
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[3] G. Causer et al., ACS Appl. Mater. Interfaces 38 35420 (2019)
[4] J. Tan et al. Nature Materials 18 35 (2019)
[5] L. Guasco et al., Nature Comm. 13 1486 (2022)

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