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Resonant neutron reflectometry for hydrogen detection in thin films.

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The study of hydrogen diffusion and storage in different materials is crucial in the challenge of an actual implementation of sustainable energy sources, but also to explore the possible modification of electronic, magnetic and optical properties of the host materials. Due to high sensitivity of neutrons to hydrogen atoms, neutron scattering techniques have been successfully used for many decades. Neutron reflectometry in particular is demonstrated to be a powerful method for the study of hydrogen absorption in thin films for atomic concentrations of 5% and higher. In this talk we will show a new model-free method which allows to measure smaller (<5%) concentrations of hydrogen absorbed in situ, with smaller counting times and with a higher sensitivity. The method is based on measuring the position of the resonance formed due to the contrast between the optical potential of a layer and its neighbours. Hydrogen absorption leads to a change of this optical potential and hence to a shift of the resonance position. We will present experiments conducted on Al2O3/Nb(x)/Co(3nm)/Nb(x)/Pt(3nm) thin films demonstrating that hydrogen concentrations below 1% and absorption kinetics of few seconds can be measured using this method.

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