

Muon Spin Relaxation in Hydrogen Tungsten Bronze

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The insertion of hydrogen into WO_3 forms a nonstoichiometric compound H_xWO_3 , called hydrogen tungsten bronze, which causes the dark blue coloration. In a WO_3 thin film the colored and bleached states are reversibly controlled by applying a voltage to take H^+ ions in and out (electrochromic effect). The electrochromic device based on WO_3 has been developed to apply smart windows and so on [1]. One of key issues for practical use is quick response. The diffusion property of hydrogen in H_xWO_3 is quite important to be understood for this purpose.

We have performed the zero field muon spin relaxation (ZF- μ SR) measurements at PSI and RIKEN-RAL in order to obtain information on the basic proton diffusion process in H_xWO_3 from the study of the dynamical property of muons. We used two powder samples of pure WO_3 and bronze H_xWO_3 with the hydrogen concentration of a few tens %. The contribution of the nuclear dipolar field from proton in H_xWO_3 was observed in ZF- μ SR spectra as shown in Fig. 1, which was extracted from the difference between two samples. The result shows the muon spin relaxation rate becomes slower as the temperature increases, suggesting that the dynamical behavior of muon in bronze is involved. The effect of muon motion extracted from the present data will be discussed.

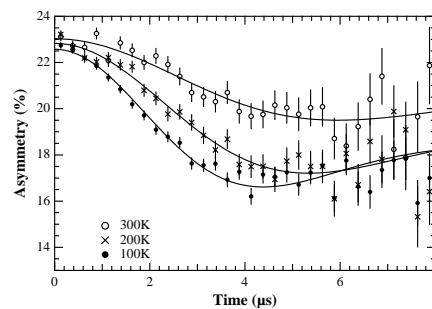


Fig. 1: Difference between ZF- μ SR spectra for WO_3 and H_xWO_3 .

[1] H. Yoshimura and N. Koshida, Jpn. J. Appl. Phys. 45 (2006) 3479.