

Muonium in Calcium Phosphate

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Stable neutral hydrogen atoms were observed at room temperature by an ESR study in X-ray irradiated tricalcium phosphate (β -Ca₃(PO₄)₂, β -TCP)[1]. The authors concluded that the hydrogen was stable for months and occupied a unique and specific site in TCP from the observed hyperfine splitting pattern caused by ³¹P nuclei. This study motivated us to use the positive muon to introduce muonium in TCP without X-ray irradiation and probe the H⁺ state by observing diamagnetic muons in β -TCP. The study aimed at obtaining detailed information about the behavior of neutral hydrogen and hydrogen ion in β -TCP.

First we tried to detect muonium in β -TCP at KEK-MSL and RIKEN-RAL. The pulsed muon beam at the two facilities limited the time resolution, and we could not determine the yield of muonium accurately due to the fast spin relaxation rate of the muonium in β -TCP. However, we confirmed the formation of muonium by using the longitudinal decoupling method.

We successfully verified muonium formation in β -TCP by observing muonium spin rotation spectra with the DC beam at PSI (Fig. 1). This yield was one of the highest muonium yields in solid chemical compounds, and as far as we know the first observation of such a large muonium fraction in oxoacid salts composed of oxoacid anion and cation.

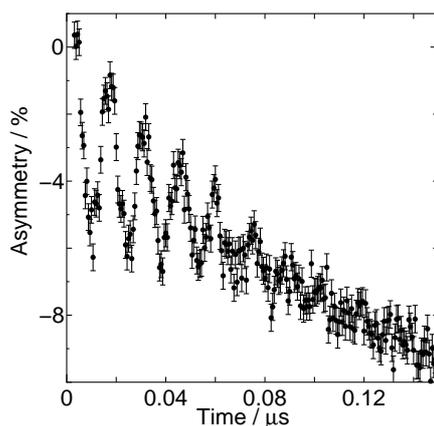


Fig. 1: A muonium spin rotation spectrum in β -TCP at room temperature.

[1] K. Nakashima and J. Yamauchi, *J. Amer. Chem. Soc.* 127, (2005) 1606.