μSR studies of the barium iridate $Ba_3MIr_2O_9$ (M = Y, Sc)

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Iridates with $5d$ electron systems have drawn much attention recently because these materials may show spin orbit coupling (SOC)-driven novel phases such as Mott-insulators, Weyl semimetals and topological insulators. In addition to the SOC effect, crystal structure is an important factor that induces novel properties. Therefore, compounds with large SOC and special structures may provide another direction to search for unconventional properties. A series of $Ba_3MIr_2O_9$ (M = Sc, Y and rare earth elements) compounds are such candidates, which show Ir-Ir dimers within the unit cell.[1)] Furthermore, the valence of Ir ions can be tuned by choosing different ions at the M site and possible charge ordering of Ir^{4+} and Ir^{5+} ions has been suggested for some compounds. A previous NMR experiment suggested a magnetic ordering in the Y sample while the magnetic ground state of the Sc sample is unclear.[2)]

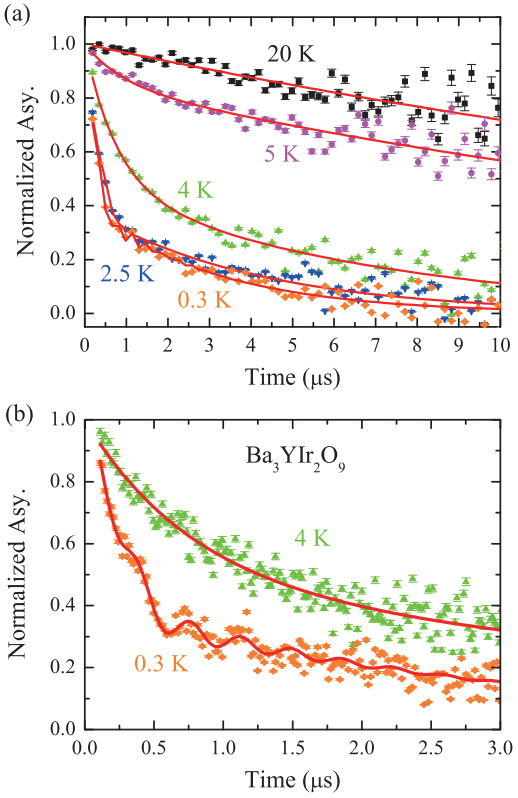

Fig. 1. Typical time spectra for the Y sample measured in the zero-field condition.

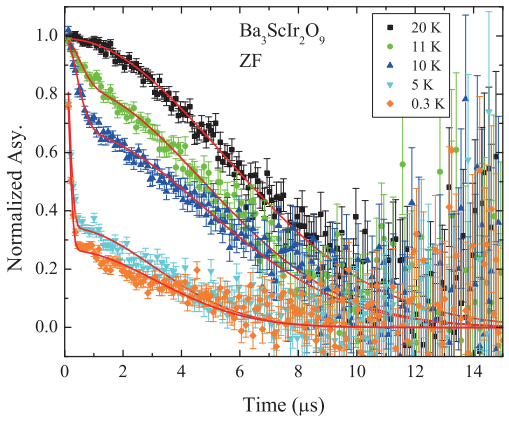

Fig. 2. Typical time spectra for the Sc sample measured in the zero-field condition.

Here, we studied the magnetic ground state of these compounds by means of μSR. Figure 1 shows the typical time spectra for the Y sample measured at various temperatures. The muon spin relaxation rate becomes faster below 5 K and clear spontaneous muon spin precession was observed below about 4 K, as can be seen from Fig. 1(b), indicating long-range magnetic ordering in this compound. The transition temperature is consistent with the specific heat measurement which shows a λ-like anomaly at 4 K. The detailed magnetic structure needs to be clarified in future studies. Figure 2 shows the time spectra for the Sc sample measured in the zero-field condition as well as a preliminary analysis. The muon spin relaxation rate becomes faster below about 10 K, but no spontaneous muon spin precession was observed down to 0.3 K. Therefore, the spin fluctuations slow down below 10 K, but no long range magnetic ordering was formed in this material. More detailed analyses of the spectra are needed.

From powder x-ray diffraction measurements, a site mixture between the Sc and Ir ions of about 8% has been observed, while no site mixture for the Y sample was observed. Such a site mixture may be the origin of the absence of magnetic ordering in the Sc sample.

References

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