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Muon Spin Relaxation Studies on Nano State Magnets at The RIKEN-RAL Muon Facility

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Muon-spin-relaxation (mSR) technique is a sensitive magnetic probe to investigate electromagnetic properties of materials. The muon is a particle and has a spin half. The muon is injected from outside to materials in order to sense electronic properties from the microscopic view point. One big advantage of the muon for material sciences is that the muon has the self spin-polarization from the beginning of its life. Thus, we can carry out spin-resonance and relaxation measurements even in the zero-field condition. RIKEN is one of the biggest national institutes of Japan and has established the RIKEN-RAL Muon Facility in the UK in 1994 [1]. World wide intense pulsed muon beams are available at this facility for material sciences and lots of international/domestic collaborations are now going on by using muons applying to variety of materials. In my talk, I am going to introduce the RIKEN-RAL Muon Facility, what is mSR and how we can make use of this research technique for material sciences. And then, I am going to report recent our mSR results on nano-gold particles.

Nano systems sometime show different electronic properties from those of bulk ones. For instance, the pure gold is expected to show a magnetic ordered state in the nano-particle state. The mechanism to appear magnetic moment in the nano state of the metal gold is still unclear but some experimental evidences to show a possible ferromagnetic ordered state have been reported [2]. It has been discussed that the magnetism in those nano-gold particles are fairly depends on the synthesis procedure of nano particles and also depends on the size of the particle. We used a well size-controlled nano-gold particle to approach to this problem. Because the magnetic moment is expected to be very tiny, mSR is an ideal tool to sense such small magnetic moments. We have chosen the middle-size nano-gold particle which contains 144 gold atoms. The size of the particle is around 1.7 nm. The first report of the observation of a possible ferromagnetic ordered state has been done in this size [3]. This size is recently well considered to be sitting in between the nano characteristics and the bulk one, so that our mSR study can give the criterion to understand how the magnetism appears in the nano-gold particles from what size of the particle.

References

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- [3] G.L. Nealon *et al.*, *Nanoscale*, **4** 5244 (2012).

Biography:

Professional Positions

1992-1994	Research Scientist, Metal Physics Laboratory, RIKEN
1994-2004	Research Scientist, Muon Science Laboratory, RIKEN
2004-Present	Senior Research Scientist, Advanced Meson Science Laboratory, RIKEN
2008-2011	Visiting Associate Professor, Physics Department, Osaka University, Japan
2011-Present	Visiting Professor, Physics Department, Osaka University, Japan
2011-2014	Visiting Professor, Physics Department, Padjadjaran University, Indonesia
2012-2014	Visiting Professor, Physics Department, Zhejiang University, China
2012-Present	Visiting Professor, Physics Department, Bandung Institut Teknologi, Indonesia
2012-Present	Visiting Professor, School of Distance Education, Universiti Sains Malaysia, Malaysia
2013-Present	Visiting Professor, Physics Department, Catholic University of Korea, Korea
2014-Present	Visiting Professor, Physics Department, Hokkaido University, Japan