MLF Experimental Report	提出日 Date of Report
課題番号 Project No. 2012B0195 実験課題名 Title of experiment Development of high pressure cell for muon spin rotation and relaxation measurements at J-PARC/MUSE and its application to organic systems 実験責任者名 Name of principal investigator Kazuhiko Satoh 所属 Affiliation Graduate School of Science and Engineering, Saitama University	装置責任者 Name of responsible person Yasuhiro Miyake 装置名 Name of Instrument/ (BL No.) D1 実施日 Date of Experiment 2012.12.2-2012.12.4

試料、実験方法、利用の結果得られた主なデータ、考察、結論等を、記述して下さい。（適宜、図表添付のこと）
Please report your samples, experimental method and results, discussion and conclusions. Please add figures and tables for better explanation.

1. 試料 Name of sample(s) and chemical formula, or compositions including physical form.

Teflon

β'-(BEDT-TTF)$_2$ICl$_2$

2. 実験方法及び結果 （実験がうまくいかなかった場合、その理由を記述してください。）
Experimental method and results. If you failed to conduct experiment as planned, please describe reasons.

Ground states of strongly correlated electron systems are very sensitive to external conditions. Especially, application of high pressure is an important technique because some of strongly correlated electron systems are located near the quantum critical point and exotic phenomena, e. g. non-Fermi liquid behavior and/or pressure-induced superconductivity, are frequently seen around the quantum critical point.

Muon spin rotation and relaxation method is an important technique to investigate microscopic magnetic properties for strongly correlated electron systems and we have continued to develop the high-pressure μSR technique at KEK and TRIUMF until now. Maximum muon momentum is about 100 MeV/c for KEK and TRIUMF, whereas it is about 70MeV/c for J-PARC MUSE D1 area. Thickness of a high pressure cell for J-PARC should be thinner and maximum pressure will be limited as compared to previous cells. Nevertheless, ground state of strongly correlated systems is sensitive to external pressure and various interesting phenomena are expected even below 1GPa. Therefore development of high pressure cell for J-PARC MUSE is valuable.

2. 実験方法及び結果（つづき） Experimental method and results (continued)

We have prepared a new high-pressure cell using non-magnetic NiCrAl alloy for J-PARC/MUSE D1 by changing the design. Maximum pressure is estimated to be 1 GPa at room temperature. In high-pressure μSR experiment, some of muons will stop at a pressure cell and it is important to determine optimum muon momentum for individual pressure cells. We first tried to determine optimum momentum by measuring μSR signal of Teflon as a function of muon momentum, since μSR signal of Teflon shows clear precession signal at low temperatures. Figure 1 shows typical μSR signal of Teflon at 40K in new high-pressure cell. Muon momentum is 72 MeV/c. By comparing asymmetry of Teflon and high-pressure cell, roughly 30 % of muon is estimated to stop at Teflon. This ratio is almost similar to the results for previous hgh-pressure cell of TRIUMF and PSI and new high-pressure cell is found to be useful for μSR experiments using 72-MeV/c muons.

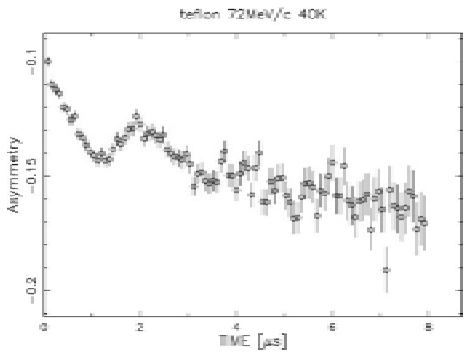

Fig. 1 μSR signal of Teflon using high-pressure cell.

We next measured μSR signal of antiferromagnetic organic insulator β'-(BEDT-TTF)$_2$ICl$_2$. Neel temperature, T_N, of β'-(BEDT-TTF)$_2$ICl$_2$ is 22 K and precession μSR signal is observed below T_N. Figure 2 shows μSR signal of β'-(BEDT-TTF)$_2$ICl$_2$ in high-pressure cell at 35 (upper) and 4.6 K.(lower). Clear precession μSR signal from β'-(BEDT-TTF)$_2$ICl$_2$ can be observed below T_N and new high-pressure cell is also useful for low density materials such as organic systems.

Although we can show usefulness of new high-pressure cell by preliminary experiments at ambient pressure, we could not carry out high-pressure experiments because of limitation of beam time. We are going to propose further experiments for high-pressure μSR for organic systems to clarify the magnetic state of β'-(BEDT-TTF)$_2$ICl$_2$ under high pressure.

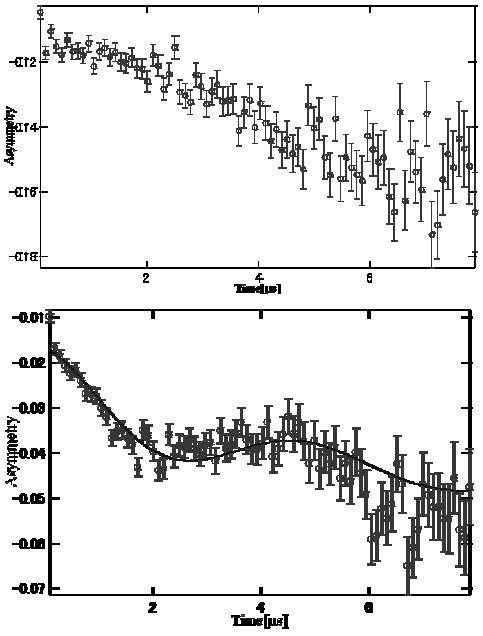

Fig.2 μSR signal of β'-(BEDT-TTF)$_2$ICl$_2$ using high-pressure cell at and 4.6K, respectively.