J-PARC MLF Experimental Report	提出日 Date of Report
課題番号 Project No. 2009B0036 実験課題名 Title of experiment μSR study of magnetic frustration in $Ce_2Ni_5C_3$ with the Shastry-Sutherland lattice just above T_C 実験責任者名 Name of principal investigator Masashi Kosaka 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 2010/01/23 - 2010/01/25

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.

・$Ce_2Ni_5C_3$

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.

The intermetallic compound $Ce_2Ni_5C_3$ has a tetragonal crystal structure with a space group *P4/mbm* [1]. The layers of Ce-Ni and C-Ni are stacked alternately along the *c*-axis as shown in Fig. 1. In this compound, the network of Ce atoms is considered as a Shastry-Sutherland lattice structure.

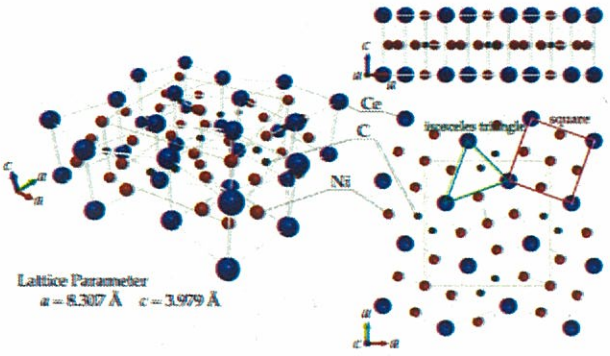

Fig. 1 Crystal structure of $Ce_2Ni_5C_3$.

A possible geometrical frustration effect has been observed in RB_4 (R=rare-earth) compounds [2, 3] and Yb_2Pt_2Pb [4], which possess the similar network of rare-earth atoms.

We have been reported physical properties of $Ce_2Ni_5C_3$. A lambda-type anomaly is observed at T_c = 2.3 K

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

ground state is considered to be a well isolated doublet and the shoulder-like anomaly cannot originate from the CEF effect. Another possible origin of this shoulder-like anomaly is the Kondo effect. The electrical resistivity data indeed shows a broad peak just above T_c. This broad peak, however, seems not to be due to the Kondo effect, since it is not suppressed by applying magnetic fields.

We expected the possibility that these features arise from a magnetic frustration effect. The behavior of the specific heat and electrical resistivity are quite similar to that of Yb_2Pt_2Pb with Shastry-Sutherland lattice, which is suggested the strong magnetic frustration [4]. Then, we planed μSR measurements in order to investigate magnetic behavior around T_c. If there is the magnetic frustration, we would be able to detect the development of dynamic internal magnetic field between T_c and 10 K.

Muon spin relaxation measurements were performed at D1 beam line. Several pieces of polycrystalline $Ce_2Ni_5C_3$, the sizes of which are about 10mm X 5mm X 0.7 mm, were placed on a thin silver plate, and then wrapped with an aluminum foil. The samples were mounted in a Helium-flow cryostat for measurements down to 2.6 K.

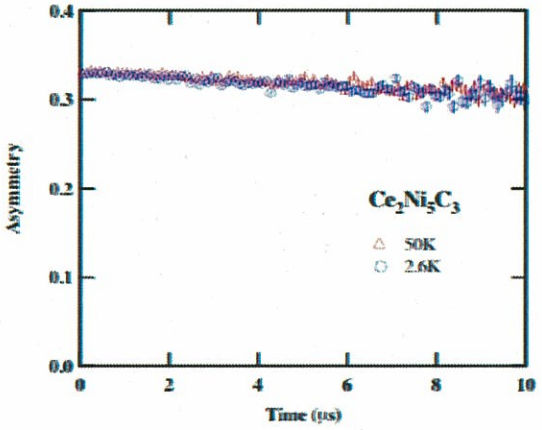

Fig. 2 The zero-field μSR spectra for $Ce_2Ni_5C_3$. The red symbols are the data collected at 50 K, and the blue symbols are collected at 2. 6K.

Figure 2 shows the time spectra of zero-field muon-spin relaxation of $Ce_2Ni_5C_3$ from 0 to 10 μs at 50 K and 2.6 K. The shape of the time spectrum does not show any changes by varying the temperature. These results imply that the development of a dynamical magnetic field and a short-range magnetic ordering do not exist even at just above T_C. Therefore, it was found that we have to devise a new model in order to explain the origin of the released magnetic entropy in paramagnetic temperature region.

References

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