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INSTALLATION EUROPEENNE DE RAYONNEMENT SYNCHROTRON

Experiment Report Form

The double page inside this form is to be filled in by all users or groups of users who have had access to beam time for measurements at the ESRF.

Once completed, the report should be submitted electronically to the User Office using the **Electronic Report Submission Application:**

http://193.49.43.2:8080/smis/servlet/UserUtils?start

Reports supporting requests for additional beam time

Reports can now be submitted independently of new proposals – it is necessary simply to indicate the number of the report(s) supporting a new proposal on the proposal form.

The Review Committees reserve the right to reject new proposals from groups who have not reported on the use of beam time allocated previously.

Reports on experiments relating to long term projects

Proposers awarded beam time for a long term project are required to submit an interim report at the end of each year, irrespective of the number of shifts of beam time they have used.

Published papers

All users must give proper credit to ESRF staff members and proper mention to ESRF facilities which were essential for the results described in any ensuing publication. Further, they are obliged to send to the Joint ESRF/ ILL library the complete reference and the abstract of all papers appearing in print, and resulting from the use of the ESRF.

Should you wish to make more general comments on the experiment, please note them on the User Evaluation Form, and send both the Report and the Evaluation Form to the User Office.

Deadlines for submission of Experimental Reports

- 1st March for experiments carried out up until June of the previous year;
- 1st September for experiments carried out up until January of the same year.

Instructions for preparing your Report

- fill in a separate form for each project or series of measurements.
- type your report, in English.
- include the reference number of the proposal to which the report refers.
- make sure that the text, tables and figures fit into the space available.
- if your work is published or is in press, you may prefer to paste in the abstract, and add full reference details. If the abstract is in a language other than English, please include an English translation.

	Experiment title: Resonant inelastic x-ray scattering study of the 4f-5d interaction in La and Ce intermetallics	**Experiment number**: HE970
Beamline: ID12A	**Date of experiment**: from:17-04-01 to:24-04-01	**Date of report**:21-08-01
Shifts:	**Local contact(s)**: A.Rogalev and F. Wilhelm	*Received at ESRF:*

Names and affiliations of applicants **(* indicates experimentalists):**
C.F. Hague*, **L. Journel*, J.-M. Mariot*, and J.-P. Rueff***,
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Report:

The purpose of these experiments was to compare the RIXS signal from equivalent lanthanum and cerium intermetallics. As is well known Ce intermetallics are mostly mixed valent. RIXS experiments performed at the Ce L_3-edge are able to pick out structure related to the "f^0", "f^1", "f^2" final states quite unambiguously. Such 2*p*3*d* RIXS experiments are complex to interpret, however, because of the difficulty of treating the interactions between *f* and conduction electrons. So far we had established that the behaviour of the "f^2"part of the RIXS spectrum is quite different according to whether extended states are involved in the hybridization with the conduction states (eg in Ce-Si and Ce-Ge) or whether *d* states are involved. Our interpretation of the data is that quadrupole transitions are not responsible for the structure observed. In the current experiments, therefore we compared data taken at the La L_3-edge and the Ce L_3-edge for equivalent Ni-based intermetallics. The advantage of examining comparable La systems lies in the fact that a simpler basis set may be used to model the RIXS data. As can be seen from figures 1 and 2, there is a very close resemblance between the La and Ce spectra with two dispersing peaks one corresponding to the "f^0" related states and the other to the "f^1"related states (La) or "f^1" and "f^2"state (Ce). The relative intensity of the «f^1» peak is very dependent on the Ni environment. By suitably modeling the RIXS process and applying the Gunnarsson and Schönhammer approach we are able to demonstrate that quadrupole transitions are not responsible for the so-called "f^1"

peak and that the RIXS experiment can be used to estimate the "f^0"/"f^1" in an analogue fashion to the XPS 3*d* measurements.

The advantage of the RIXS experiment over XPS is that it is clearly a probe of bulk properties. Also RIXS reflects an excited state of the atom whereas in XPS the atom is ionized in the final state. We are presently working on a model to describe the Ce data and ascertain if it is possible to extract a set of parameters relevant to the hybridization of *f*–orbitals and conduction states.

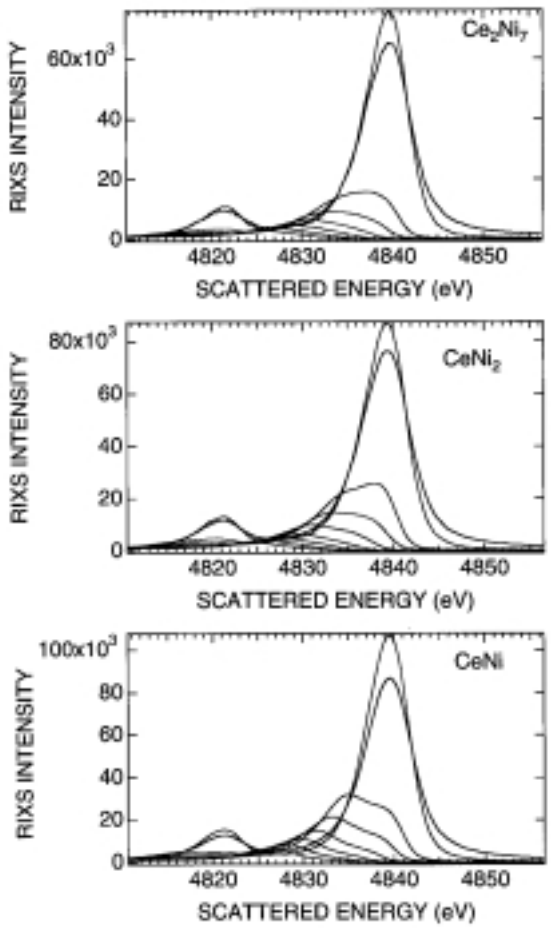

Figure 1 Ce 2*p*3*d* RIXS Ce-Ni intermetallics: CeNi (bottom) $CeNi_2$ (middle) and Ce_2Ni_7 (top)

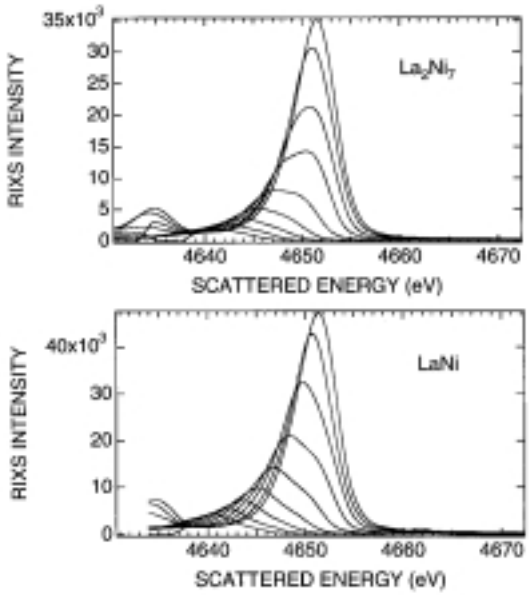

Figure 2 La 2*p*3*d* RIXS LaNi (bottom) and La_2Ni_7 (top)