ESRF	**Experiment title:** Resonant inelastic x-ray scattering at the Ce L3 edge in covalent compounds	**Experiment number:** HE-415
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Report:

Our resonant inelastic x-ray scattering (RIXS) experiments concerned with mixed valent Ce intermetallics have enabled us to demonstrate that this second order optical process is sensitive to subtle modifications in the electronic structure of 4f-5d hybridization (see report on experiment HE-333). At present, our measurements on different categories of Ce intermetallics, multilayers, or compounds give us access to parameters which contribute to a qualitative description of the processes involved, but it must be said that there is no reliable quantitative theory which can presently be applied. Theorists, working in the field, have yet to meet the challenge of being able to treat atomic-like 4f orbitals and conduction states (especially 5d) in highly correlated materials on a comparable footing, though interesting efforts are being made [see, for instance, Laegsgaard and Svane Phys Rev B 58 12817 (1998)].

Our aim is to vary the 4f-5d hybridization by means of alloying and changes in temperature. Also we are actively studying 4f-5d exchange interaction modulated by the presence of a 3d element which requires the use of magnetic circular dichroism techniques. In our latest measurements we have been working on:

– Mixed valent covalent compounds: here we give CeO_2 as an example.

– Magnetic circular dichroism applied to RIXS in $CeFe_2$

Figures 1 and 2 illustrate a set of data taken for CeO_2. A series of interesting features are observed. Starting from the low energy transfer side, we see two marked peaks at ≈ 880 eV and 883 eV corresponding to intermediate state quadrupole transitions (the two structures correspond to transitions to a spin parallel and a spin antiparallel intermediate state). At low excitation energies (bottom curves) the incoming photons are detuned relative to the dipole-allowed 2p-5d transition but two peaks are clearly identified at ≈ 887 eV and 891 eV. They correspond to $2p^54f^1v$ and $2p^54f^0\underline{v}$ intermediate states also clearly observed in the absorption spectrum. The increased intensity of the first peak relative to the second as the incident photon energy is a consequence of enhancement by the slope of the incoming excitation. Extra structure between the two peaks (not observed at L_3 absorption spectrum) is also observed. We attribute it to valence state hybridization with O 2p states. At higher transfer energies we observe the same features repeated at the $3d_{3/2}$ part of the spectrum. These data combined with previous measurements on ionic compounds will help in the interpretation of the mixed valent intermetallics.

Our latest measurements are still being analysised, but it is worth mentioning that we have observed x-ray magnetic circular dichroism in the resonantly excited inelastically scattered spectrum of $CeFe_2$. Even so it should be pointed out that count rates in our RIXS spectrum are at least three orders of magnitude smaller than in an XAS experiment.

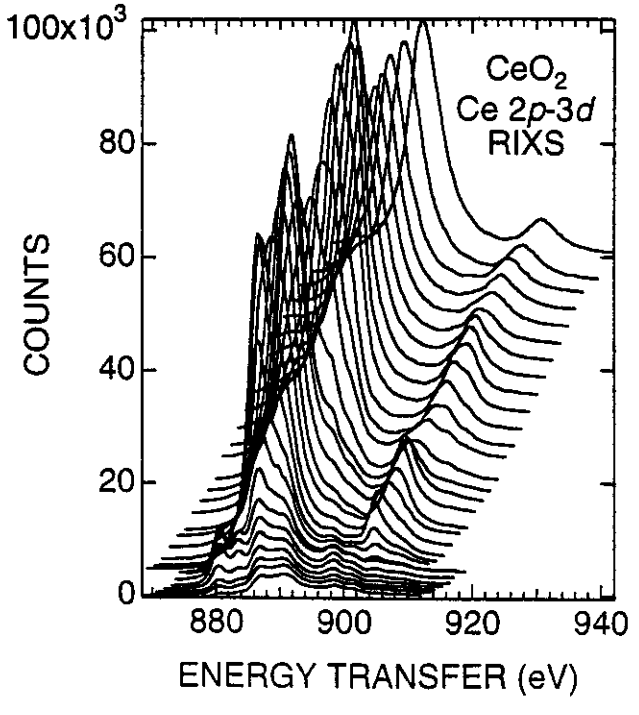

Figure 1

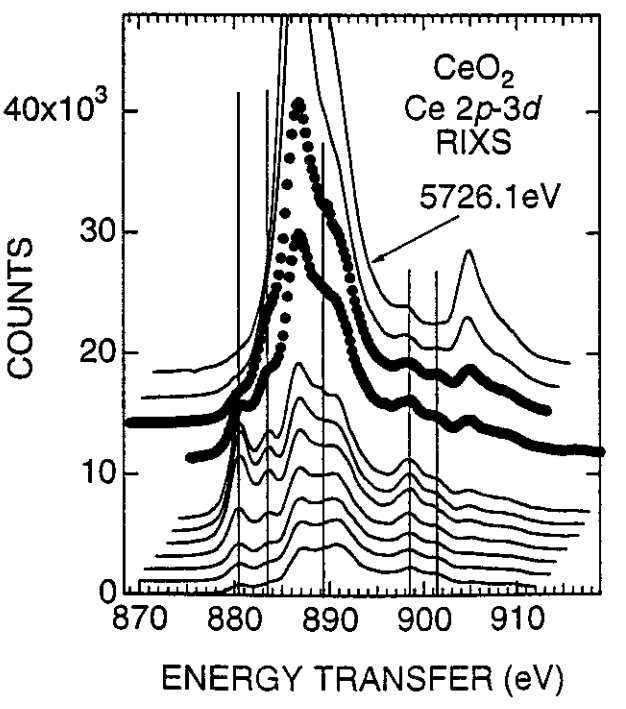

Figure 2