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Report:

The aim of the experiment was the study the dynamics of the intermediate state in some Transition Metal (TM) and Rare Earth (RE) systems, looking at the emission spectra in inner shell processes of the type $(2p^6 3s^2 3d^n) \rightarrow (2p^5 3s^2 3d^{n+1}) \rightarrow (2p^6 3s^1 3d^{n+1})$ and $(3d^{10} 4p^6 4f^m) \rightarrow (3d^9 4p^6 4f^{m+1}) \rightarrow (3d^{10} 4p^5 4f^{m+1})$ respectively. The radiative de-excitation in both cases is due to an inner shell transition leaving the system in an excited state with a core hole. With respect to the usually more intense emission involving valence electrons, inner shell transitions do not suffer from self-absorption effect. For all the analysed samples the spectra have been collected both at the energy of the inner shell and the valence state decay in order to compare the behaviour of the two processes (that have the same intermediate state). This will require a careful data handling because of the self- processes in the case of the valence decay. We were able to obtain for several samples a complete series of spectra showing the behaviour of the system versus the exciting photon energy.

Measurements were attempted on the following polycrystalline systems: Co0 and metallic La, $CeRh_2$, Ce_7Rh_3, Yb.

i) The Co0 was chosen as Co" instead of the Co ferrite mentioned in the proposal, which we would use in a dicroic measurement, due to the higher concentration of the TM element and the consequent higher counting rate. From the raw data presented (fig. **la)** it is clearly visible that the de-excitation via the "Raman" process suffers from the strong competition of a process with intermediate state relaxation giving rise to the so-called fluorescence emission. This was already seen in the NiO system in previous experiments.
A comparison between the valence (fig. lb) and the inner shell processes (fig. **la)** might give information about the Branching Ratios (BR) of the elastic, "Raman" and relaxed processes. We note that the Super Coster-Kronig conversion of the L_2 in the L_3 holes seems to be unequivalent for the subsequent radiative processes involving valence or inner shell electrons. Also to note is the apparent shift toward lower emission energies of the fluorescence peak when exciting between the L_2 and L_3 absorption edges.

ii) The La metal sample (fig. 2) shows a behaviour that is by far more complex and rich in details than the Co0 one. At the moment we only stress two points: a) There is a long tail at lower energies with respect to the peak in the inner shell de-excitations (fig. **2a).** This can be probably attributed to the configuration~interaction between the final state with one 4p hole and the one with two 4d holes. Gd metal has already shown this behaviour in a previous experiment: this was the main motivation of the present experiment. b) Information can be obtained about the intermediate state relaxation and the SCK conversion in a way similar to the Co0 case.

iii) We have measured some preliminary data (not presented here) from the Ce compound systems showing a tail similar to the ones of La and Gd metal. This supports the interpretation of this behaviour as a general one for this kind of systems. The two systems have strongly different hybridisation of the valence electrons and show **marked** differences in the spectra

iv) The tentative measurements on the Yb system were unsuccessful because of the low counting **rate.** This could be attributed to the absence of a strong absorption resonance in Yb and to the lower photon flux of the beamline at this energy.