



**Experiment title:**  
**High resolution Compton scattering study of  
Nanocrystalline metals**

**Experiment  
number:**  
HE 677

**Beamline:**  
ID 15B

**Date of experiment:**  
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*Received at ESRF:*

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**Report:**

The aim of this experiment was to study the modification of the electronic structure at the interface of metallic nanocrystals with powder samples prepared under different conditions and with different grain sizes. Since only few thousands atoms are contained in the grains with large part at interface (up to 30 % of the total number), we were waiting an observable effect on the Compton profile, i.e. on the wave functions.

The experiment has been performed with the scattering angle settled at  $160^\circ$  and the synchrotron radiation has been monochromatized at 55.8196 keV. We have measured two Nanocrystalline samples prepared under different conditions both for Ni and Fe, plus Ni and Fe polycrystalline references, i.e. a total of 6 Compton profiles.

The data sets have been corrected for energy dependent effects such as photoelectric absorption in sample, analyser and air (photon path between sample, analyser and detector).

We made the difference between the profile measured for one sample and its reference in order to follow the change in the shape of the Compton profile due to the surface influence. Moreover, many of the systematic errors cancel when one profile is subtracted from another. Figure 1 presents the result obtained for one sample of Ni and its reference :

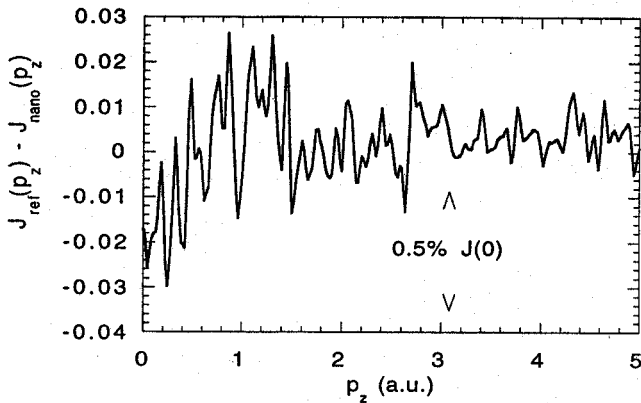


Figure 1 : profile difference between the Ni reference and a nanocrystalline Ni sample.

First of all, the highest difference visible at low  $p_z$  is very small : it is less than 0.5% of the maximum of the Compton profile  $J(0)$ . Let us note that we usually observe differences of magnitude 1 or 2% of  $J(0)$ . The statistical accuracy was not sufficient for allowing us to conclude to a real observable effect due to the surface, even if qualitatively the obtained results suggest a higher delocalisation of outer electrons in the nanocrystalline samples than in references. Nevertheless, one can conclude that the size of the nanocrystalline samples was too high for the surface effect to be measurable. Enrico Campari (Univ. of Bologna) is working on elaborating smaller nanocrystals which should contain only few hundreds atoms for Compton scattering to be able to test the size effect on wave functions.