ESRF	**Experiment title:** **Local structure of fresh and damaged (U,Pu)N fuels.**	**Experiment number**: CH 3635
Beamline: BM20	**Date of experiment**: from: 23/11/12 to: 27/11/12	**Date of report**: 15/03/13
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Fuels operating in a nuclear reactor are subjected to severe operating conditions, due to irradiation damage, evolution of new phases, and the differential thermal gradient. The damage to the structure of the fuel is particularly important for the degradation of macroscopic properties such as the thermal conductivity. The cause of this degradation lies in defects within the lattice. A recent study on UO_2 [1] has shown that the thermal conductivity is associated with changes in the lattice parameter of the fuel, which increases with self irradiation damage. The lattice parameter does not supply complete information, as it does not account for any non periodic regions of the lattice, and reflects changes in the longer length dimension of the symmetry. This sort of information can only be determined from short range methods, which focus on the individual atom and its immediate surroundings.

In this context, XAS (X-ray Absorption Spectroscopy) is one of the most suitable techniques to assess such information since it allows obtaining atomic local environment and cation valence state. Therefore, the purpose of this work is to study, using XAS, (U,Pu)N nitride damaged fuels. These materials, which were fully characterized after their fabrication, have been prepared in the framework of NILOC and NIMPHE programs [2]. These pellets wre stored for more than 20 years at ITU (Institute for Transuranium Elements) and will be used for this experiment. Performing XAS measurement on damaged samples allow to directly study the effect of the irradiation on the local bond lengths and on the degree of static disorder in the system.

XAS spectra were collected at room temperature in transmission mode at the U L_{III} and in fluorescence mode at the Pu L_{II} edge. Both U L_{III} and Pu L_{II} EXAFS spectra were fitted considering a NaCl type structure (*Fm-3m*). The experimental and fitted EXAFS spectra are presented in the Figure 1. A good agreement between the experimental and fitted data is observed, confirming the validity of the structural model used for the analysis. No additional Me-N or Me-Me distances were needed to reproduce the experimental data,

confirming the complete local integration of Pu in the NaCl structure. Considering the experimental uncertainty, this also indicates that the anion and cation atoms are still located on the theoretical atomic positions of the NaCl structure, i.e. no atoms ejected in interstitial positions through the energy of the self-irradiation process could be detected. As would have been expected, this shows that, despite the self-irradiation, a solid solution is still conserved.

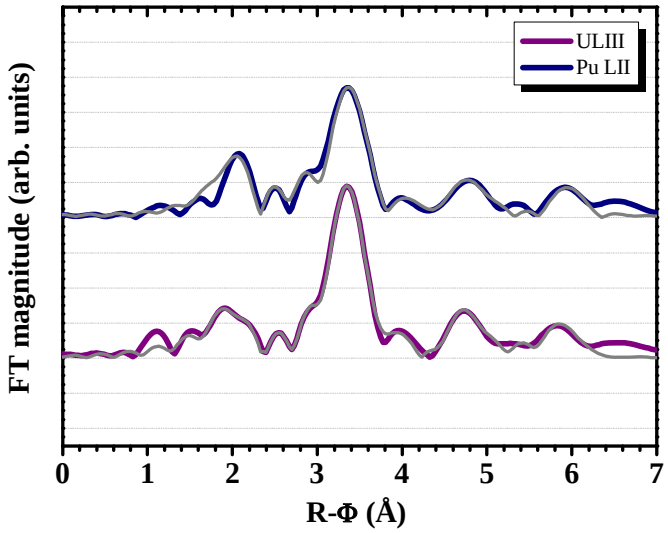

Figure 1: U L_{III} and Pu L_{II} k^3-weighed EXAFS spectra of damaged $U_{0.78}Pu_{0.22}N$ NIMPHE fuel.

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