

Report of the experiment 08-01-298

The aim of the experiment was to determine the local order around Ag, Pd and Cu in Pd+Ag, Pd+Cu implanted silica so investigating the role of preparation parameters in giving rise to different cluster structures. This was accomplished by EXAFS analyses at the Ag, Cu and Pd K-edges. We have recorded the EXAFS spectra, for each dopant species, after different heating treatments in reducing or oxidizing atmosphere, to follow the thermal- and chemically-induced structural evolution of the alloy nanoclusters. The data analysis is still in progress. Anyway, some main points can be stated:

- as expected, during the annealing in reducing atmosphere, the dopant atoms dispersed in the matrix after the implantation aggregate to form larger alloy clusters.
- the alloy composition changes during the annealing in reducing atmosphere: in particular for the Pd+Cu-implanted silica we detect a chemical reduction of the oxidized Cu atoms that aggregate in the clusters, whose alloy composition (Pd-rich alloy in the as-implanted sample) is almost balanced after 1h annealing.
- for the Pd-Cu alloy clusters, we observed a deviation from the virtual crystal approximation. Work in progress.
- the air annealing of the Pd+Cu implanted sample is quite complex. While in the case of Au+Cu implanted silica the air annealing ($T=900\text{C}$) promotes a selective de-alloying [G. Mattei et al., PRL 2003], in the actual case, after 1 h annealing part of Cu atoms are oxidized, but we did not detect the formation of large CuO crystalline clusters, that were the dominant phase for Cu in the Au-Cu system (EXAFS investigation, experiment 08-01-195). Moreover, Pd-Cu alloy nanoclusters are still present after 1h annealing, while in the Au-Cu systems the dealloying process was almost completed (we detected only the presence of Au and CuO clusters). The reasons for this behavior are still under investigation.