

Report of the experiment MA660: XAS on Er-Au doped silica to single out the sensitizing agent (Au oxidized or Au aggregates) for the Er PL intensity.

We have measured the Au L_{III} -edge XAS spectra of 10 different samples each one formed of a SiO_2 amorphous slide sequentially implanted with Er and Au. The measurements were performed at $T=20$ K, in high resolution x-ray fluorescence detection mode (3 Ge crystal analyzer were used + a Si drift diode). We have explored the effect of the annealing temperature (from RT to 800 C) and atmosphere (inert or reducing) on the Au site. The high resolution fluorescence detection allowed to investigate the oxidation state of Au atoms by the white line analysis of the edge region, see the figure (left panel) for the case of neutral annealing (the arrow indicates increasing temperature): it is clear that, while in the as implanted most of Au is dispersed and oxidized, the annealing at higher temperature induce the complete clusterization of Au. The results of the XAS analysis allow to measure i) the average cluster size (typically less than 1 nm); ii) the metallic fraction and iii) the cluster density. In particular, in the figure (right panel) the average number of atom per cluster is reported as a function of the annealing temperature, for two different implantation doses and annealing atmosphere. It is clear that the annealing parameters can be used to finely tune the cluster size in the sub-nanometer range. Moreover, while the chemical effect of the annealing atmosphere is evident at high temperature/high Au doses (annealing in reducing agent promotes the formation of smaller clusters), it is practically absent at low Au concentration (green data). These results have been related with the peculiar optical properties of this system and a paper is in preparation.

