

XAS STUDIES OF THE REACTION OF GOLD(III) COMPLEX IONS WITH THE SODIUM HYDROXIDE AND GLUCOSE IN ACIDIC AND ALKALINE AQUEOUS SOLUTION

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The kinetics of hydrolysis reaction of gold(III) chloride complex ions has recently been studied mainly with spectrophotometry UV-Vis [1] or potentiometry [2]. However, these two techniques have some disadvantages in such an application. First, they can not be applied when the gold(III) complexes lose chromophoric groups and therefore do not absorb electromagnetic radiation in the UV-Vis region. The second one, based on the measurements of redox electrode potential, does not provide information about structures of the reactants as well as the products. Additionally, the response of such an electrode is too slow to detect the changes during relatively fast reaction.

In our study of the reaction described above we have applied the X-ray absorption spectroscopy in order to investigate changes in the structure of gold(III) complex ions during the reaction with sodium hydroxide as well as with glucose. The EXAFS and QEXAFS experiments were carried out at Hasylab/DESY in Hamburg. A special sample holder was constructed at the X1 beamline to enable the detection of the course of these reactions. All EXAFS spectra of the solutions were recorded in transmission at the Au-L₃ edge, and QEXAFS spectra were collected during the reaction every 60 second. The hydrolysis was carried out at ambient temperature (20°C) using 1x10⁻³ M HAuCl₄ solution in 0.1 M HCl and 0.1-0.5 M NaOH as reactants. A comparison of the spectra obtained before and after the hydrolysis (Fig. 1), indicate differences in the structures of gold(III) complex ions. They are attributed to the substitution of chloride ligands by the hydroxyl ions.

From all the experiments we had carried out, it was not possible to detect the changes in the structure of gold(III) complex ions during the time of reaction, because of too high rates of the process, comparing with the detection time. However, good quality spectra were obtained before and after the reactions from which the

changes in the structure of these complex ions were determined (characteristic bond length for Au-Cl and Au-OH were derived). The results obtained were compared with the simulated spectra of the possible different gold(III) complex ions, present in the solution. On this basis the mechanism of the reaction was suggested.

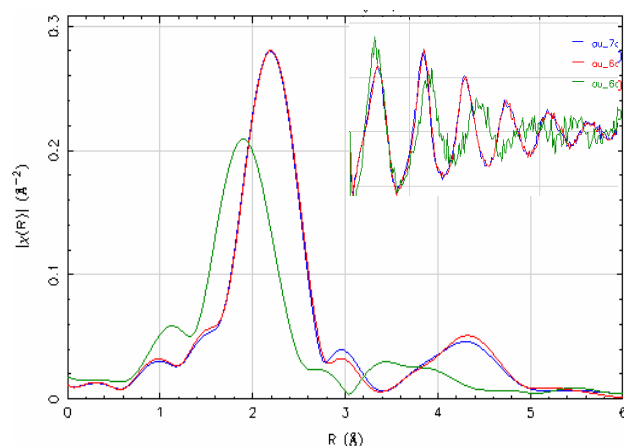


Figure 1. EXAFS functions at subsequent stages of the hydrolysis of gold(III) chloride complex ions in aqueous solution. Blue and red – pH = 1, green – pH = 8.

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References

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