

Electrodeposition of ^{210}Po on Cu and Ag electrodes from various aqueous solutions and their mixtures with organic solvents

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In two series of experiments, yields of the spontaneous electrodeposition of polonium were measured. The carrier-free solutions of ^{210}Po in 0.1M HCl and in 0.1M HNO_3 were prepared as described in [1]. Those solutions were used either in their pure form or in a 1:1 mixture with organic solvents. Due to the addition of these solvents, one can influence the viscosity of the solution. By doing so, a direct effect on the deposition velocity can be achieved.

The experiments performed with the pure solution showed a clear advantage of the HCl solution in comparison with the nitric acid solution. As shown in fig. 1, the achieved yields with the 0.1M HCl after 5min of reaction time are already close to 100%. In contrast to this, only about 50% of the polonium was deposited from 0.1M HNO_3 under otherwise identical conditions (fig. 2).

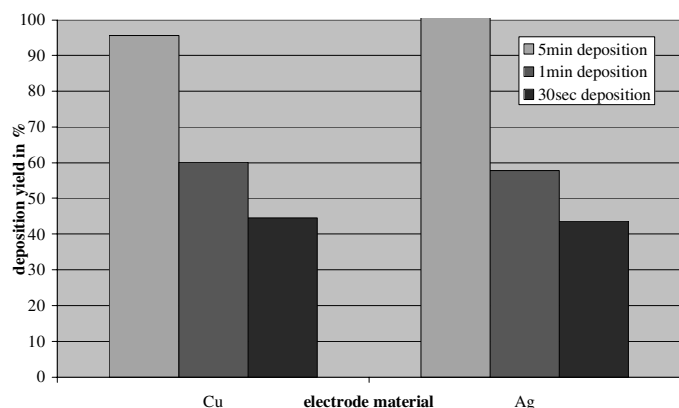


Figure 1: Deposition of ^{210}Po on Ag and Cu from 0.1M HCl.

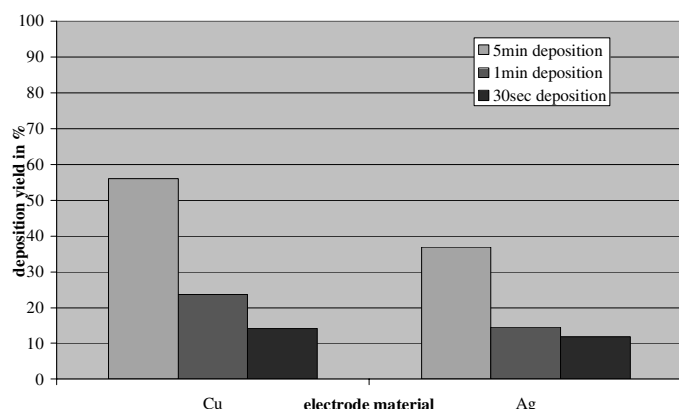


Figure 2: Deposition of ^{210}Po on Ag and Cu from 0.1M HNO_3 .

As qualitative interpretation of this observation, the oxidizing properties of the nitric acid could be taken into account. This might prevent the necessary reduction step of the deposition of polonium ions from taking place. As a consequence the whole electrodeposition process is slowed down in nitric acid solution as compared to the HCl solution.

In the second series of experiments, the polonium solutions were mixed with 50-vol% of various organic solvents. These mixtures were contacted with the electrodes for 1min. From figure 3, one can see that these solvent additions have a strong effect on the deposition yields. While dioxane additions reduce the deposition yields due to an increase of viscosity, the addition of acetonitrile significantly increases the yields by reducing the viscosity of the solution.

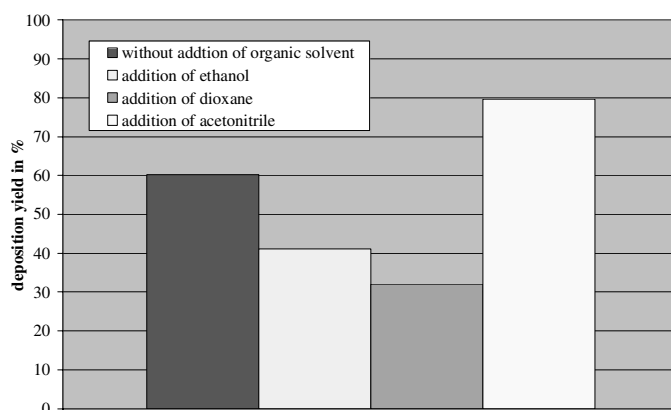


Figure 3: Deposition of ^{210}Po on Cu from 0.1M HCl with various organic solvents added.

These observations are in very good agreement with a theoretical consideration of Hummrich et al. [2] which shows that the time until a 50% deposition yield is reached is directly proportional to the viscosity of the solution.

References

- [1] U. Rieth et al., GSI, *Scientific Report 2002*, p.183.
- [2] H. Hummrich et al., GSI, *this report*.