Development of Diffusive Gradients in Thin-Films (DGT) for the measurements of gold, silver and platinum in aquatic systems

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INTRODUCTION

- ***Backgrounds:*** Au, Ag and Pt are the top three precious metals (PM) entering the wastewater treatment plant (WWTP) in Brussels[1]. Although 52-99% of them can be removed after treatment, there is still 0.28, 24.6 and 0.04 kg of Au, Ag and Pt being discharged into the Zenner River per year. Considering the toxicity of Au, Ag and Pt nanoparticles reducing from Au-, Ag- and Pt-ions by the cells in biotas[2], PM in the effluent could risk the biotas in the Zenner River.
- ***Current status:*** The concentrations of PM are under the limitation of detection of ICP-MS by grab sampling. DGT can overcome the limitation of traditional grab sampling method by passive accumulation, which provides the quantitative *in-situ* measurements of labile metals level in the aqueous system[3].
- ***Objectives:*** 1) develop a DGT which is specified for Au, Ag and Pt
  2) to evaluate the risk of available Au, Ag and Pt in the Zenner River.

MATERIAL AND METHODS

Uptake kinetics

- Standard solutions (Au, Ag, Pt) were taken before (C_0) and after (C_t) S920 resin immersed at different time points.
- Uptake (%) = $\frac{C_o - C_t}{C_0} * 100\%$

Capacities of the S920 resin for Au, Ag and Pt

- For Au, S920 resin gels were immersed in the Au standard solutions in a range of 10-10000 µg/L.
- For Ag and Pt, S920 DGTs were immersed in 200 µg/L standard solution (Ag, Pt) for 7 days. 2 DGTs were sampled every day.

Diffusion coefficients of Au, Ag and Pt

- S920 DGTs were immersed in 20 µg/L standard solution (Au, Ag, Pt) for 3, 6, 9, 12 and 24 h.
- $C_{DGT} = \frac{M \cdot \Delta g}{D \cdot A \cdot t}$
  - C_w, concentration of a target compound
  - M, mass of a target on the resin gel
  - Δg, the thickness of diffusive gel
  - D, diffusion coefficient
  - A, exposure area
  - T, exposure time

Selectivity of S920 resin for trace metals

- S920 resin gels were immersed in wastewater for 24 h.

Elution and Analysis

- All the targets on the S920 resin gels were eluted by 1 mL AR at 65°C for 12h.
- Samples were diluted 10-1000 times before analysis by ICP-MS.

ACKNOWLEDGEMENTS

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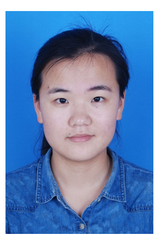
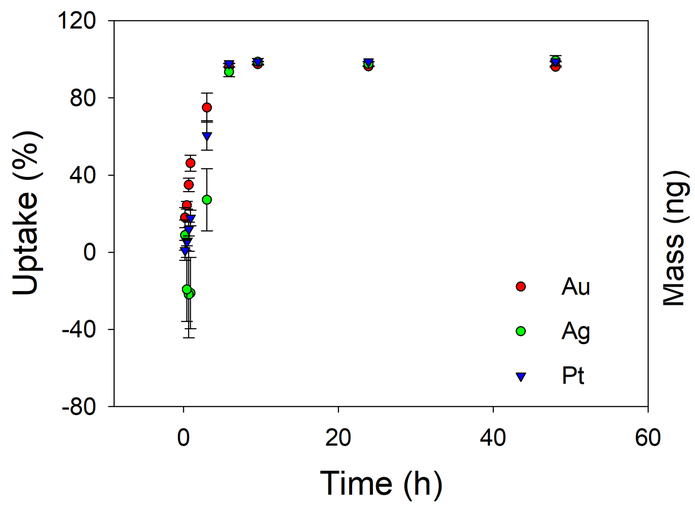
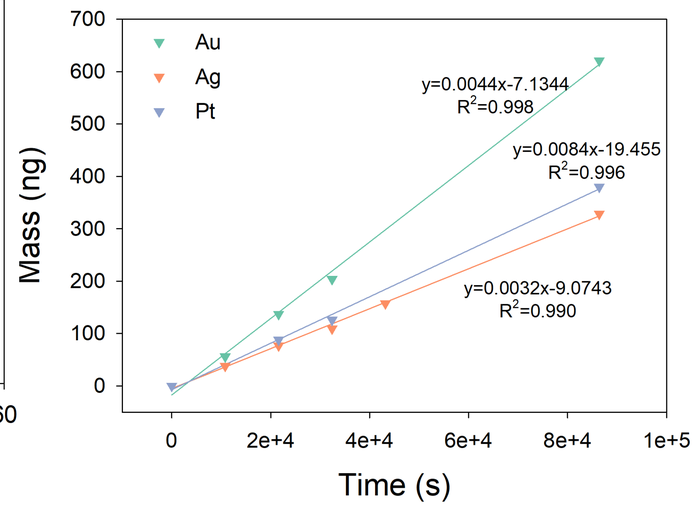


RESULTS

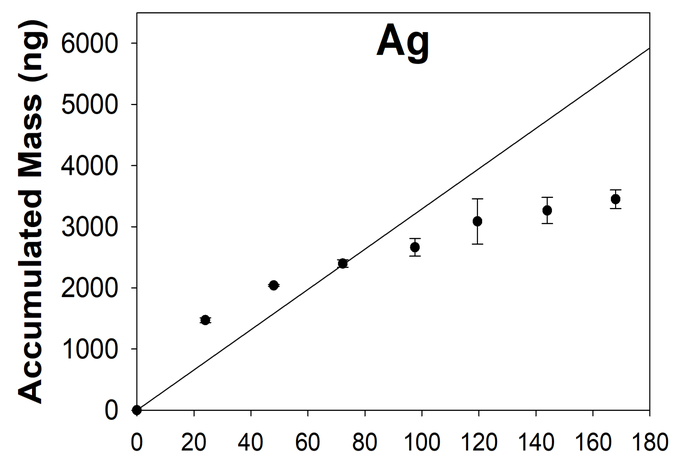
➢ *Uptake of Au, Ag and Pt by S920 resin*

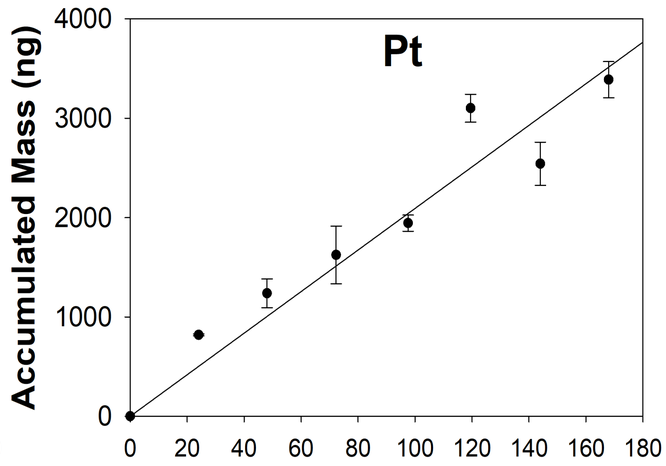


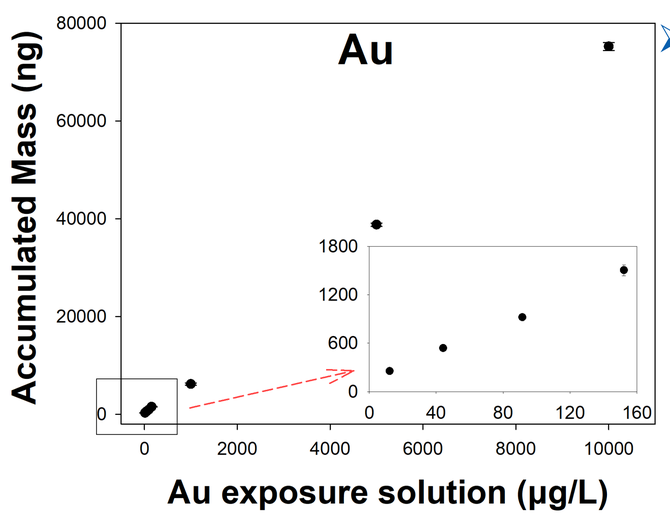
➢ *Diffusion coefficients of Au, Ag and Pt in the hydrogel*



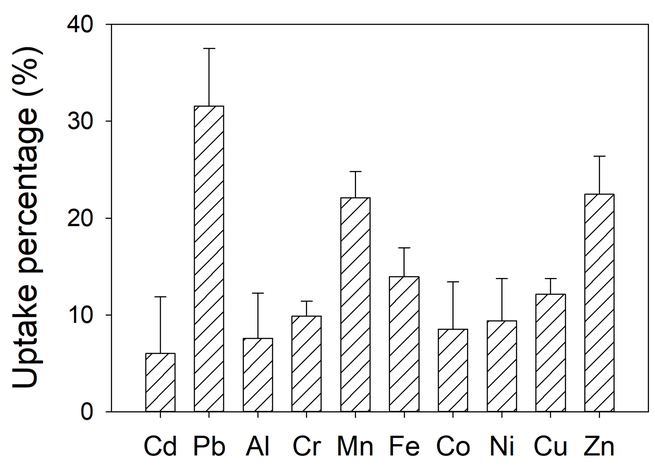
➢ *Capacities of the S920 resin for Au, Ag and Pt*







➢ *Selectivity of S920 resin for trace metals*



CONCLUSIONS

❑S920 resin has rapid uptake for Au, Ag and Pt and showed sufficiently high capacities for the binding of them.

❑The effective diffusion coefficients of Au, Ag and Pt in agarose diffusive gel are 6.35E-06, 8.40E-06 and 3.49E-06 cm^2/s at 25°C, respectively.

❑S920 resin has strong selectivity for Au, Ag and Pt.

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