Optical and Electrochemical Sensing with Gold Nanoparticles

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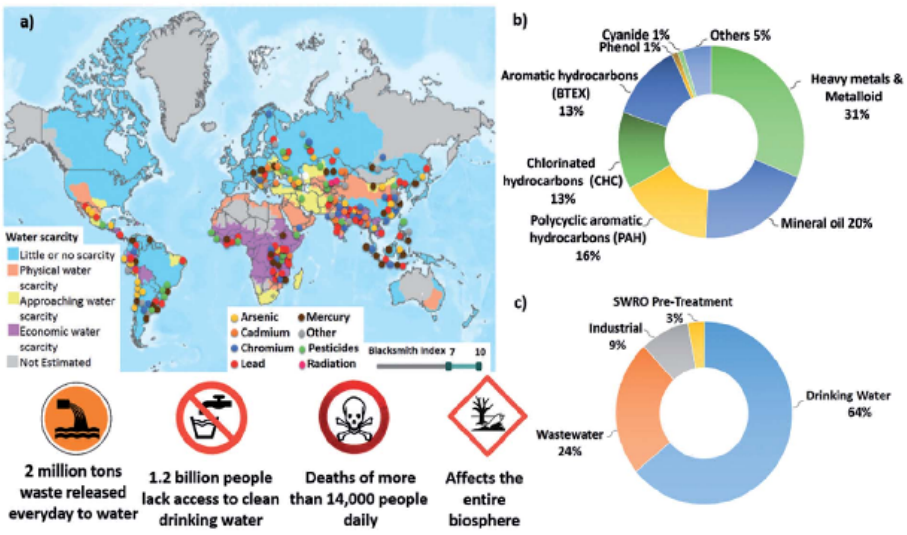
INTRODUCTION

In developing countries around the world, drinking water contaminated with heavy metal ions (especially arsenic) is a global health problem. According to the World Health Organisation (WHO), more than 1 billion people are affected to a greater or lesser extent.



Summary of worldwide global water contamination. [1]

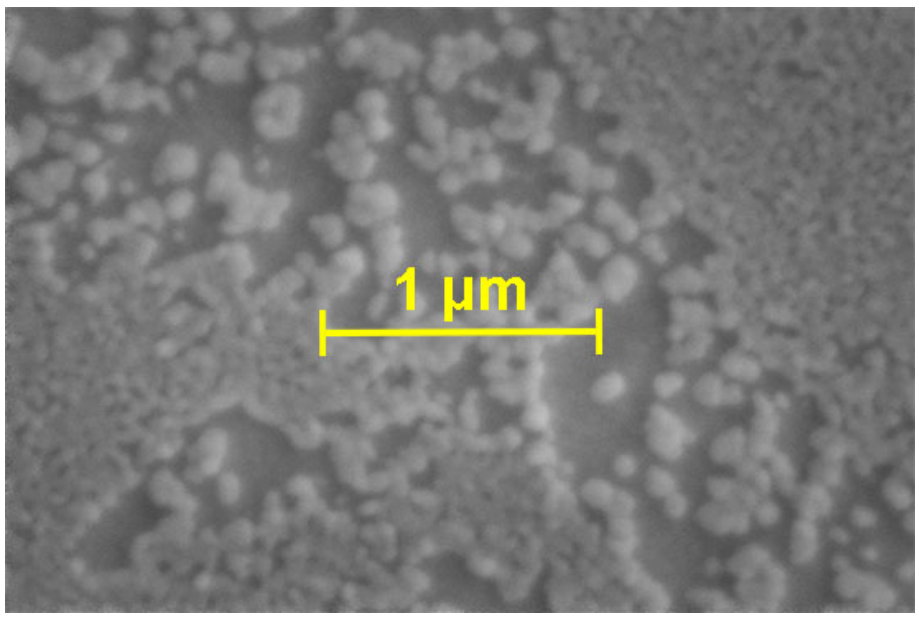
AIM

I aim to develop a sensor for heavy metal detection that can easily evaluate liquid samples at the sampling site. Based on modern scientific knowledge available test methods are not suitable for routine field testing. A portable electrochemical sensor, in addition to providing higher accuracy than test kit methods using stripes, would be less burdened by the human error factor. [2]

Rapid test kit for in situ detection of heavy metal ions. [3]

METHODS

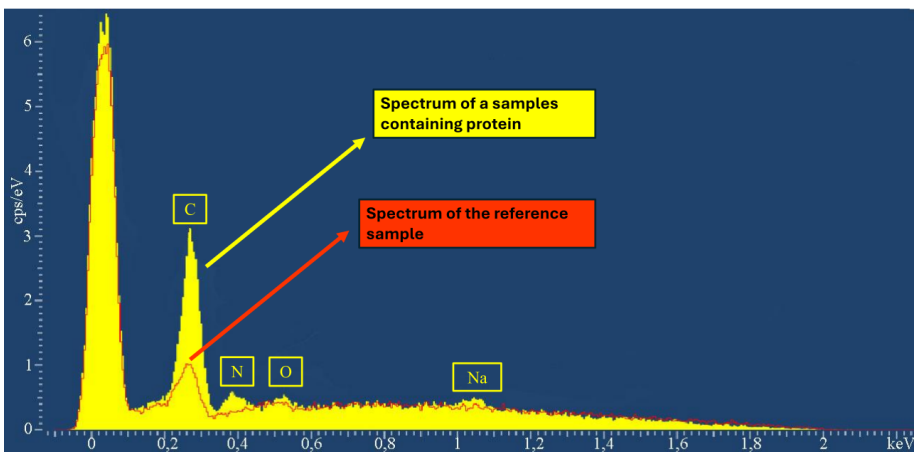
In this work, gold nanoparticles were created from solution in a controlled manner by measuring the surface area during layer formation using nanometre-sensitive optical methods, and then, after the formation of a suitable layer, protein filaments suitable for binding heavy metal ions (mainly nickel) were attached to the sample. [4]



Evaluation of gold deposition by SEM at 50 000x magnification.

RESULTS

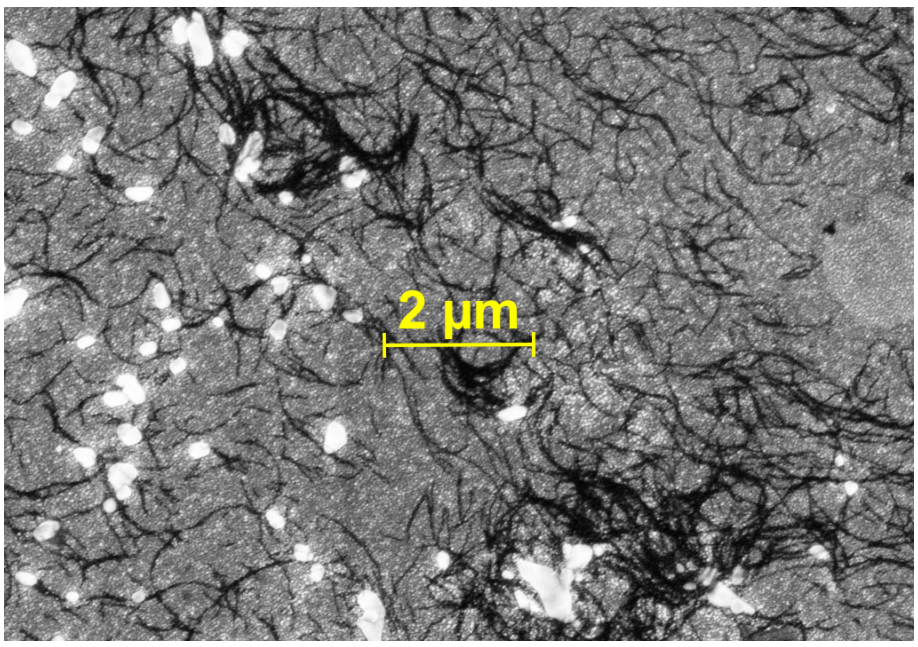
Using the untreated sample as a reference (red line), it can be seen that the ratio of carbon and nitrogen is higher in the protein-layered part (yellow spectrum). Nitrogen is only present in the protein filament, so the higher value of nitrogen on the treated surface clearly demonstrates the success of the deposition. [5]



Comparison of protein covered and untreated surfaces by energy dispersive X-ray spectroscopy.

FUTURE PLANS

We would like to use AI in the form of an image detection algorithm to evaluate the deposition.



Evaluation of specific protein filaments by SEM at 25 000x magnification.

- PROBLEM 1: It requires a high level of routine to decide whether certain parts of the SEM image provide relevant information.
- PROBLEM 2: There is a lack of available data, as no other research group other than ours deposit the same specific protein filaments on a surface formed by gold nanoparticles in order to detect heavy metal ions.

REFERENCES

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