Spectrophotometric MEMS approaches for Heavy Metal Detection in Electroplating Processes: IntelWATT EU Initiative Insights

Giulia Mossotti[1]*, Felice Catania[1], Andrea Piscitelli[2], Luciano Scaltrito[1] and Sergio Ferrero[1]

[1]Politecnico di Torino, Dipartimento di Scienza Applicata e Tecnologia (DISAT), Corso Duca Degli Abruzzi, 24, 10129 Torino, Italy

[2] Microla Optoelectronics Srl , Per Via Gozzano, 34, 10034 Chivasso (TO), Italy

**E-mail: giulia.mossotti@polito.it*

Research context and motivation

- Nowadays, **contamination of heavy metals (HMs) in waters**, caused by the anthropogenic release, **is a global issue**.
- In the field of green technology, **devices that are able to detect the concentration of these elements are essential**. They are required not only for measurements on common drinking water, where the low limit of concentration are set by law, but also for metal detection in industrial processes, such as electroplating, where the concentrations are higher.
- In this research effort, emerging Micro Electro Mechanical System (MEMS) technologies, such as lab-on-a-chip, are used to address market demands by combining chemical processes with electrical interfaces and to generate manufacturable devices.
- One of the project's aim is to **develop a system for *in situ* for online autonomous and real-time monitoring of HMs detection**.

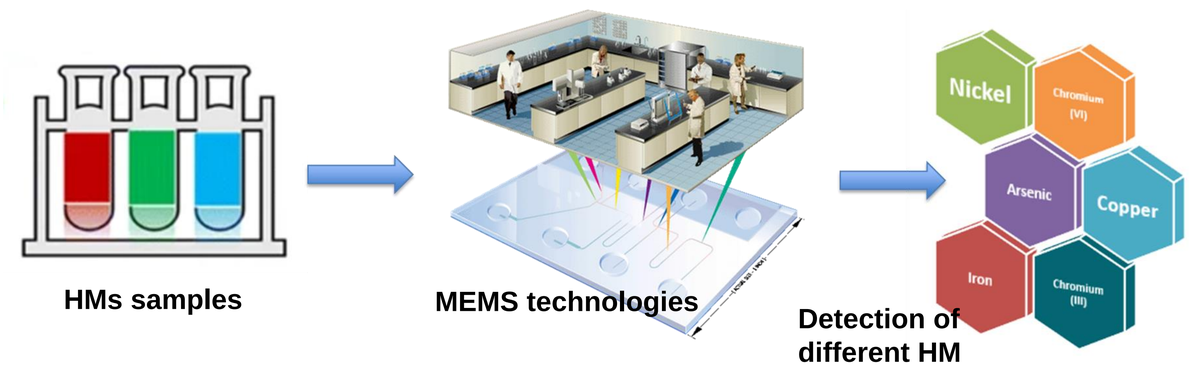

***Figure 1**: Schematic representation which describe the detection of HMs*

Novel contribution

- A mix of interdisciplinary abilities in chemistry, materials science and engineering will be required to **design new sensor**. The goal is to create an instrument that can provide several outputs at the same time by combining various approaches and instruments.
- The final device can be employed by different industries that require **close control of the parameters** described above to obtain an excellent final product, such as the electroplating industry, to ensure excellent quality of the final product.
- On the other hand the wastewater, that can come from these sectors, must be closely controlled because could have a negative effects on the environment and ultimately deadly impact on human health.

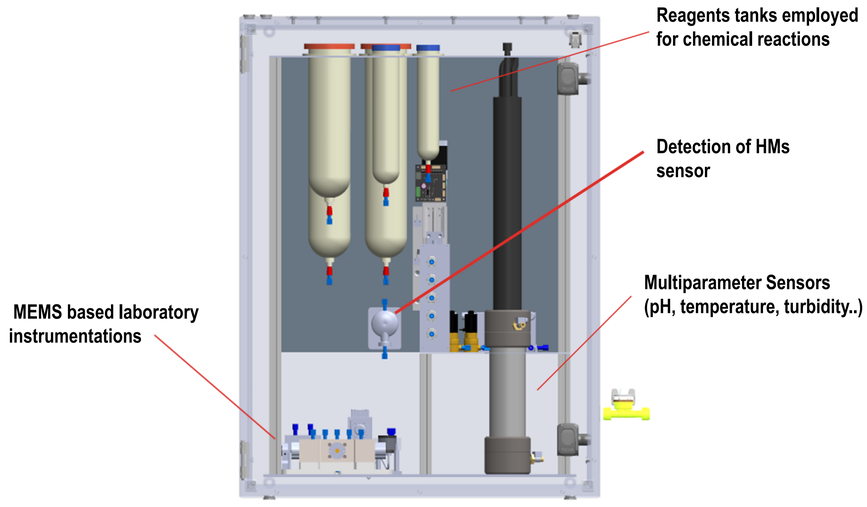

Figure 3: Rendering final measuring device with related components to be implemented.

- The analytical results point out the follow results:
  - Minimum detectable concentration is 90ppm.
  - Maximum detectable concentration is 4,3 g/L

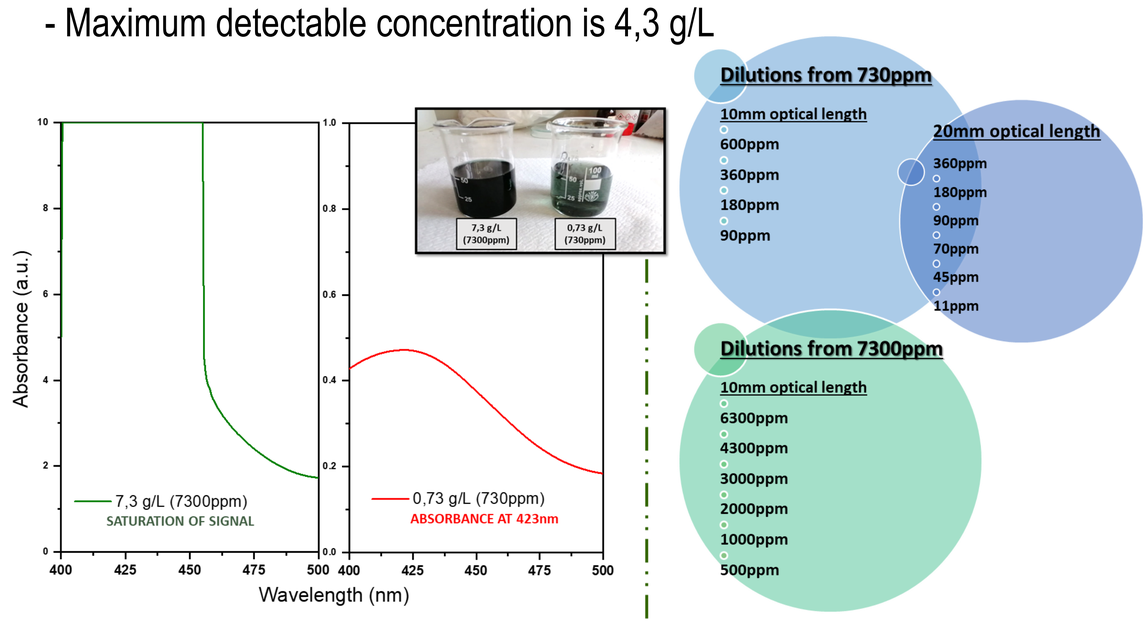

Figure 4: Evaluation of different range concentrations of Chromium (III) with UV-Vis

Adopted methodologies

- **UV Vis spectrometry:**
  - Principle: Lambert-Beer law
  - Instrument set-up
  - Colorimetric detection: choosing the method in relation to assumed quantity
  - Choosing the correct optical length related to analyte concentration

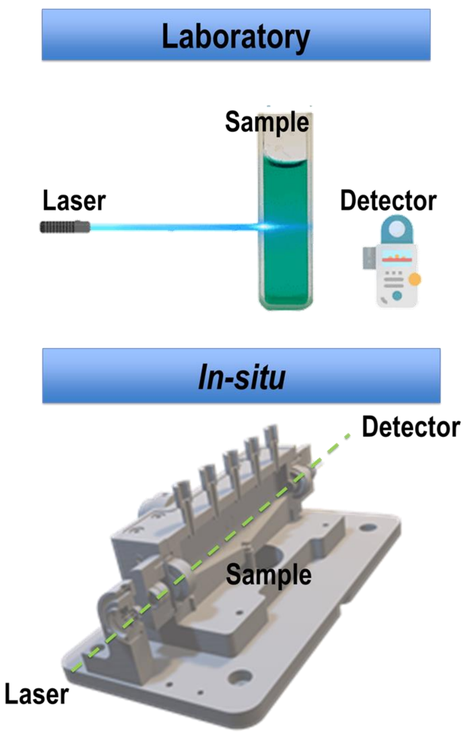

Figure 2: Methodologies adaptation from laboratory to in field analysis.

Future work

- **Design and 3D printing cuvette with different optical length** to detect wide range of concentration using MEMS automatized system technology.

Publication

Mossotti, G. et al. (2023). Spectrophotometric Detection of Nickel in Water by Lab-on-a-chip Technology: Application to Electroplating. Chemical Engineering Transactions, 99, 127-132

Acknowledgements

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 958454.