

## PLASMA PENCIL EMISSION RESPONSE ON COMBINED MATRIX SOLUTIONS.

**Magda Dvořáková**, Ales Hrdlička, Masaryk University, CEITEC MU, Central European Institute of Technology, Kamenice 753/5, Brno, CZ-62500, Faculty of Science, Department of Chemistry, Kotlářská 2, Brno, CZ-61137, Pavel Slavíček, Masaryk University, Faculty of Science, Department of Physical Electronics, Kotlarska 2, Brno, CZ-61137, and Viktor Kanický, Masaryk University, Faculty of Science, Department of Chemistry, Kotlářská 2, Brno, CZ-61137, Czech Republic; ahrdlicka@chemi.muni.cz

Plasma pencil is a capacitively coupled discharge (CCP) operated in a quartz tube (i.d. 2 mm). It was originally designed for modification of surfaces of various objects of cultural heritage. Argon is most commonly used plasma gas but other gases (e.g. helium) and their combinations are possible use as well.

In the field of analytical chemistry its potential to be an alternative excitation source for determination of elements concentrations in solutions is investigated [1, 2]. Liquid samples for the plasma pencil are processed by the same way as for inductively coupled plasma (ICP). A peristaltic pump with suction and drain tubing are used. The liquid aerosol is created in a concentric nebulizer and modified in a double pass Scott spray chamber using the carrier gas. The discharge can excite elements of 1<sup>st</sup> and 2<sup>nd</sup> group of the periodic table and also some other metals of which melting and boiling temperatures are not high related to the pencil plasma. Among them mainly copper and zinc emissions were already studied under various conditions. It was shown that intensities of their atomic lines are suppressed by the presence of easily ionisable elements (EIE: 1<sup>st</sup> and 2<sup>nd</sup> group of the periodic table) in the sample solution [3]. The suppression was also found in the presence of nitric acid.

This work studies copper and zinc atomic lines emission in dependence on solutions composition covering various cations and anions of alkali salts as nitrates, chlorides and sulfates, also in combinations with acids. Sodium was chosen as the first cation for experiments with various anions. The intensities of both copper and zinc lines always decreased in presence of sodium and the decrease was deeper for copper lines with increasing sodium concentration. However, significant differences were found for different anions in combination with sodium cation in the salt. Although the experiments have not been completed yet, it seems that the most intensive depression effect is caused by chlorides, less effect is observed for nitrates and sulphates and the dependence on the sulphate concentration is not monotonous.

To find out if a plasma pencil can be used as an alternative excitation source, we have analyzed real drinking water samples. We selected three samples of different origins. The standard addition method and the calibration method were used for sodium, magnesium, potassium and calcium cations content determination. ICP-OES was also employed for the same experiments. The data evaluation has not been completed yet, but we can say that the results of the two discharges do not differ significantly.

### References:

- [1] L. Novosad, A. Hrdlicka, P. Slavicek, V. Otruba and V. Kanicky, *J. Anal. At. Spectrom.*, **27**, 305 (2012).
- [2] L. Novosad, A. Hrdlicka, P. Slavicek, V. Otruba and V. Kanicky, *J. Anal. At. Spectrom.*, **30**, 459 (2015).
- [3] M. Dvorakova, A. Hrdlicka, P. Slavicek, V. Kanicky and V. Otruba, *J. Anal. At. Spectrom.*, **31**, 2031 (2016).

### Acknowledgement:

This work was financially supported by the Ministry of Education, Youth and Sports of the Czech Republic under the project CEITEC 2020 (LQ1601) under the National Sustainability Programme II, by the project CZ.1.05/2.1.00/03.0086 funded by European Regional Development Fund and project LO1411 (NPU I) funded by Ministry of Education Youth and Sports of the Czech Republic.