EFISH and LIF diagnostics of dielectric barrier discharge used for atomization of tin hydride

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Hydride atomizers are a useful tool in analytical chemistry for the ultra-trace determination of elements such as As, Se, Pb, Sn, Bi, Sb, or Te. Their role is to decompose volatile analyte hydrides to free atoms which can be detected by atomic absorption or fluorescence spectroscopy.

Our work focuses on the diagnostics of one particular type of hydride atomizer based on volume dielectric barrier discharge (DBD) ignited in a mixture of argon, hydrogen and analyte gas in atmospheric pressure. The atomizer is used for the decomposition of tin hydride (stannane). Two regimes of power supply are used: sinusoidal applied voltage and rectangular applied voltage with frequencies 34 kHz and 28 kHz, respectively. Previous studies have shown that the DBD with rectangular power supply has better efficiency to decompose stannane: it reveals up to three times higher absorption signal on tin atoms, compared to the sinusoidal power supply [1].

For understanding the processes leading to better performance of rectangularly powered DBD, we used various laser diagnostics techniques. Firstly, we used the laser-induced fluorescence (LIF) method to determine the spatial profile of the absolute concentration of tin atoms inside the atomizer in both power supply regimes. Secondly, two-photon absorption LIF was used to measure the concentration of atomic hydrogen, which is supposed to be responsible for the analyte decomposition. Third, the electric field induced second harmonic generation (EFISH) method was used for the determination of electric field evolution during one period of applied voltage. The results of all the methods will be presented and suggestions on possible further improvement of DBD atomizer efficiency will be discussed.

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References

[1] L. Juhászová, et al., Spectrochimica Acta Part B 158 (2019) 105630