Improving SALD ICP MS Repeatibility Using Cold Plasma Treatment of Substrate

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Keywords: SALD ICP MS, dried droplet sample, surface modification, plasma treatment, DCSBD

Introduction:
Substrate-assisted laser desorption inductively coupled plasma mass spectrometry (SALD ICP MS) is a technique for inorganic analysis of liquid samples of sub-microliter volumes in the form of dried droplets on suitable plastic substrates.[1] Here we study influence of aging effects on analysis of cadmium and indium in samples prepared by diffuse coplanar surface barrier discharge (DCSBD)[2] modification of plastic substrates.

Methods:
A DCSBD device (RPS400-Roplass plasma system 400 W, Roplass, Czech Republic) was used for treatment of plastic substrates at 400 W. Contact angle of the deposited droplet with Cd and In was measured using See System E, Advex Instruments, Czech Republic. Samples were desorbed in ablation cell (UP213, New Wave Research, USA) with a 213-nm laser, and content of ^{111}Cd and ^{115}In analyzed by a quadrupole ICP mass spectrometer (7500ce ICP-MS, Agilent, USA).

Results:
Four plastic substrates (polyethylene terephthalate glycol PETG, polyethylene terephthalate PET, polycarbonate PC and styrene-acrylonitrile SAN) were exposed to cold plasma for 1, 5 and 10 s. Droplets of Cd and In solutions in citrate, biological culture medium and cell lysate were deposited in five replicates immediately, 1, 3, 6 days, 1, 3 or 6 months after the treatment on the plastic substrates. Droplet contact angles as well as size of the generated stains were characterized. Typically, longer treatment of surface substrate resulted in lower contact angle. The stain diameter first increased to a maximum at deposition 1 day after the treatment and then gradually decreased. Also, the longer the surface treatment was, the slower was return to the original state (high contact angle). Using In as an internal standard for determination of Cd significantly reduced RSD, e.g. from ~30 to less than 10 %.

Conclusions:
Aging of the surface treated by DCSBD has been monitored using physical methods and related to SALD ICP MS of samples prepared on the surface. The initial experiments show significant changes in contact angle, stain size and SALD ICP MS response. Using an internal standard, RSD values were reduced to <10 %. A half-year monitoring is under progress; a procedure for surface treatment and sample preparation will be recommended after completing the entire set of analysis.

Novel Aspect:
Substrate surface treatment by DCSBD for dried droplet preparation. Systematic characterization of surface aging and its consequences for SALD ICP MS reproducibility.

References:

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We acknowledge the financial support of the Czech Science Foundation (GA18-16583S) and the Ministry of Education, Youth and Sports of the Czech Republic under the project CEITEC 2020 (LQ1601).