Further investigation into ICP-induced elemental fractionation in LA-ICP-MS using a local aerosol extraction strategy

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The source and degree of elemental fractionation is one of the remaining challenges in LA-ICP-MS. In this study, the ICP-induced fractionation behavior of 63 elements was studied using a local aerosol extraction strategy while using a 193 nm excimer laser ablation system for sampling. We found that the sampling distance between the ablation site and the gas outlet nozzle tip positively correlated with the size of the laser ablation produced aerosol particles or agglomerates in the local aerosol extraction strategy. Therefore, the local aerosol extraction strategy allowed detailed studies of the ICP-induced fractionation behaviors for different elements. At a low makeup gas flow rate of 0.6 L min^{-1} (hot plasma conditions), the increase in the size of aerosol agglomerates or particles because of the increased sampling distance from 1 mm to 10 mm does not affect the ionization efficiency of the sample aerosol in ICP. In contrast, at a high makeup gas flow rate of 0.9 L min^{-1}, the normalized signal intensities of the elements significantly differ when the sampling distance increases from 1 mm to 10 mm. These experimental results suggest that the changes in the size of aerosol particles or agglomerates under our given conditions do not affect the transport efficiency of aerosol particles but affect the vaporization of aerosol particles in ICP. The mass load effect is more significant in the presence of large amounts of large aerosol particles and agglomerates, which deteriorates the vaporization of aerosol particles. Our experimental results also show that the sample position in the normal ablation cell affects the size of laser ablation produced aerosol particles or agglomerates. The high velocity of the carrier gas flow rate on the ablation site facilitates the production of small aerosol agglomerates or particles. To reduce the ICP-induced fractionation behaviors in LA-ICP-MS, hot plasma conditions and high velocity of the carrier gas flow rate on the ablation site are required.