Laser Ablation ICP-MS: particle size-dependent isotopic fractionation of copper in laser-generated aerosols

H.-R. KUHN[1], N.J. PEARSON[2] AND S.E. JACKSON[3]

[1] GEMOC, Macquarie University, Sydney, hkuhn@els.mq.edu.au
[2] GEMOC, norm.pearson@mq.edu.au
[3] GEMOC, sjackson@els.mq.edu.au

Laser induced isotopic fractionation

Previous studies of laser ablation (LA) MC-ICP-MS analysis of Cu metal and sulphides showed reduced $^{65}Cu/^{63}Cu$ ratios compared to solution nebulisation MC-ICP-MS of the same samples [1]. The fractionation of about 30ε (parts per 10,000) was reproduced repeatedly and observed, to a smaller degree, for Ag and Sb also. This deviation, which was attributed largely to preferential vaporisation of ^{63}Cu in the ICP, seriously reduces the accuracy of the results.

Recently published research has demonstrated that the origin of *elemental* fractionation in LA-ICP-MS is the result of a combination of laser- and ICP-induced fractionation [2]. The laser impact produces two distinct phases in the ablation plume – relatively large (μm scale) melt droplets and much smaller (<10 nm) particles which are the product of condensation from a vapour phase. The more volatile elements were shown to be enriched in the condensate which is much more efficiently vaporized in the ICP than the larger melt particles. A similar effect can be expected for isotopic fractionation, where the lighter isotopes could be enriched in the smaller particles leading subsequently to lower measured $^{65}Cu/^{63}Cu$ ratios.

Presented work

The isotopic compositions of different aerosol particle size fractions (larger than, and smaller than, 250 nm) has been studied. The Cu metal target was ablated using a 213 nm Nd:YAG laser using various ablation conditions. Particles were dissolved in acid and analysed in solution on a Nu Plasma MC-ICP-MS. This has revealed a difference in the isotopic composition of large and small aerosol particles of up to 5ε, with lighter isotopes enriched in the smaller particles. This deviation is too small to explain the previously documented variations of up to 30ε but it shows that the width of the particle size distribution generated by laser ablation plays an important role in isotopic fractionation. The effect is further enhanced by preferential vaporisation of the lighter isotopes from incompletely vaporised particles in the ICP.

Different strategies to overcome the problem of laser-induced isotopic fractionation will be discussed.

References

[1] Jackson S.E. and Günther D. (2003), *JAAS* **18**, 205-212.
[2] Kuhn H.-R. and Günther D. (2004), *JAAS* **19**, 1158-1164.