

Rapid Analysis of Rare Earth Elements by Microwave Plasma Torch Coupled with the Linear Ion Trap Mass Spectrometry

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ABSTRACT: a sensitive mass spectrometric analysis method based on the microwave plasma technique is development for the fast detection of rare earth elements (REEs) in aqueous solution at the trace level. The plasma was produced from an Ar assisted microwave plasma torch (MPT) under atmospheric pressure, and was directly used as ambient ion source of a linear ion trap mass spectrometry (LTQ). ambient solution flowed across the plasma flame through the central cube of the MPT, without any other pretreatments. For the REEs including La, Ce, Pr, Eu, Nd, Sm, Y, etc., the generated complex ions in plasma were detected in both positive and negative ion modes and further characterized in collision induced dissociated (CID) experiments. These mass spectra showed that these REEs could keep their original valence state as in aqueous through the plasma excited, which is distinct from that of the ICP-MS. Under the optimized conditions, the limited of detection (LOD) of these REEs, using MS² procedure, were estimated to be at the level 10⁻¹⁰g/ml with a linear dynamics rage larger than 2 orders of magnitude. The analysis of a single aqueous sample can be completed in 2~3 minutes with a reasonable semi-quantitative sense. Two practical aqueous samples and orange juice were analyzed qualitatively without extraction separation of REEs. These experimental data demonstrated the MPT-MS is hopeful to be applied in scene analysis involving several fields, such as environment controlling, food safety and living-body, and can be used as the supplement of ICP-MS.

KEY WORDS: microwave plasma torch; rare earth elements; ambient mass spectrometry; valence state

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