

液体電極プラズマ発光分光法による再処理工程試料中の金属元素の分析技術開発

(4) 高放射性廃液中のストロンチウムの定量

Development of analytical methods for metal elements in reprocessing solution by optical emission spectrometry based on liquid electrode plasma

(4) Determination of strontium in highly active liquid waste

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An analytical technique for determination of elemental strontium in highly radioactive liquid waste (HALW) using liquid electrode plasma optical emission spectrometry (LEP-OES) has been developed. The method is validated using simulated HALW and comparing with inductively coupled plasma spectrometry (ICP-OES).

Keywords: Liquid electrode plasma, strontium, highly radioactive waste, elemental analysis.

1. Introduction There is a need of determination of Sr, one of the major fission products, in spent nuclear fuels stream for the further treatment of the HALW. Our previous study shows that it is possible to analyze Sr by LEP-OES, which is a compact device recently employed in our laboratory [1,2]. This present work focuses on further characterization and validation of the method in order to realize its practical application.

2. Experiment The LEP-OES instrument is described in our previous report [1]. Using the same equipment condition, we evaluated the effect of applied voltage from 800 V to 900 V and acidity of matrix from 0.05 M to 1 M. Then, the developed method was validated using a simulated HALW sample in comparison with a standard measurement with an ICP-OES (ICPE-9000, Shimadzu, Japan).

3. Results and discussion Figure 1 shows Sr emission lines observed by LEP-OES at 407.8 nm, 421.5 nm, and 460.7 nm with relative intensities of 0.15, 0.1, and 1, respectively. Nitric acid concentration is the key factor in sensitivity improvement. Accordingly, the emission intensity of Sr increased by six times as nitric acid concentration increased from 0.05 M to 0.6 M. Then, the intensity almost did not change with further increase of nitric acid concentration up to 1 M. The applied voltage resulted in an improvement by 1.4 times in sensitivity as the voltage increased from 800 V to 900 V. Limit of detection (LOD) and limit of quantification (LOQ) were determined to be 0.05 mg/L and 0.18 mg/L, respectively. The effect of coexisting metal elements was negligible because the simulated HALW was diluted by a factor of 5000. Figure 2 shows a good agreement between LEP-OES and ICP-OES in measurement of Sr. Precision presented as relative standard deviation is about 10 % for the measurement of 5000-fold diluted SHALW. An application to a real HALW sample is being carried out.

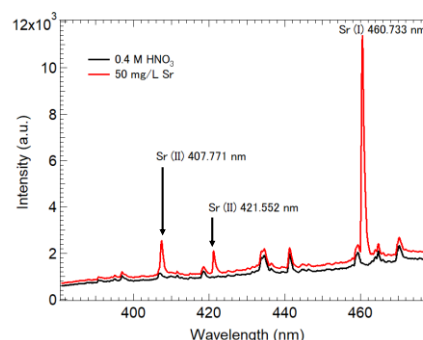


Fig. 1 Emission spectra of Sr

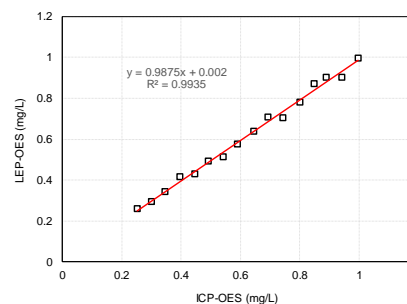


Fig. 2 Comparison of LEP-OES and ICP-OES

References [1] S. Taguchi et al, Proceedings of 2017 Fall Meeting of AESJ, 3K10. [2] V.-K. Do et al, Proceedings of 2017 Fall Meeting of AESJ, 3K11.

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