

Design and simulation for a ^{90}Sr analysis apparatus based on quadrupole mass spectrometry, ion guide and ion trap

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Abstract

^{90}Sr is one of the most important fission products from a nuclear reactor, which may cause severe inner exposure once entering human body through food chain transportation. This presentation aims at introduction upon design and simulation for a ^{90}Sr analysis method based on quadrupole mass spectrometry, ion guide and ion trap by SIMION.

Keywords: ^{90}Sr analysis, SIMION, quadrupole mass spectrometry, conical octupole ion guide, ion trap

1. Introduction

Fig.1 shows the schematic of the methodology.

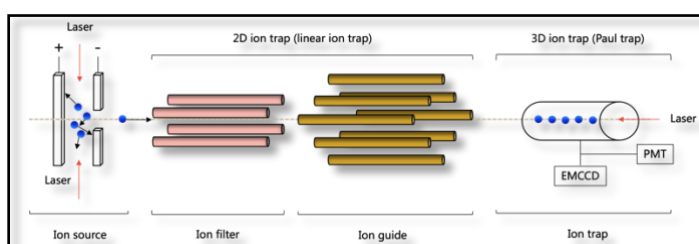


Fig.1 Schematic of the methodology

SIMION has been used for realizing the model of this method. The model can be separated into three parts, namely quadrupole mass spectrometer (QMS), conical octupole ion guide system and ion trap. Simulations for ion transmission has been

conducted on this model.

2. Design for each part

The structure of QMS is shown in Fig.2 (left), this part including the structures of ion source region, lens before quadrupole filter, quadrupole pre-, main- and post-filters. QMS is working at the peak point of stable area of Mathieu equation, which is capable to specifically select $^{90}\text{Sr}^+$ and kick off other ions.

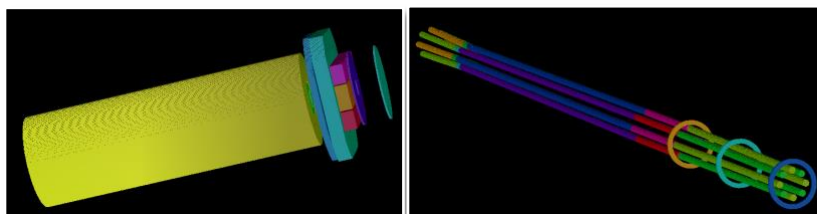


Fig.2 (left) QMS model in SIMION; (right) Conical octupole system in SIMION.

Conical octupole system, shown in Fig.2 (right), is used as an ion guide

here, to supply a better constraint effect and a mild pushing force for ions decelerated by the helium gas after gas chamber^[1].

Ions transported from QMS and conical octupole system will be trapped and cooled in a Paul trap, simultaneously counted and visualized by gathering the characteristic spectrum from the excitation-deexcitation process.

Experiment mainly focused on calculation the ion transmission. The constraint effect and contribution of conical octupole system for optimizing the transmission rate has been quantified by different simulations.

3. Conclusion

A new design for ^{90}Sr analysis method has been finished and evaluated in SIMION, which shows the feasibility of whole methodology. The design of conical octupole system is capable to improve the ion transmission rate substantially.

References

[1] Shao, Q., and J. Zhao. "Ion trajectory simulations of a conical octupole ion guide and its comparison with a parallel one in chemical ionization mass spectrometric applications." *Rapid Commun Mass Spectrom* (2018).