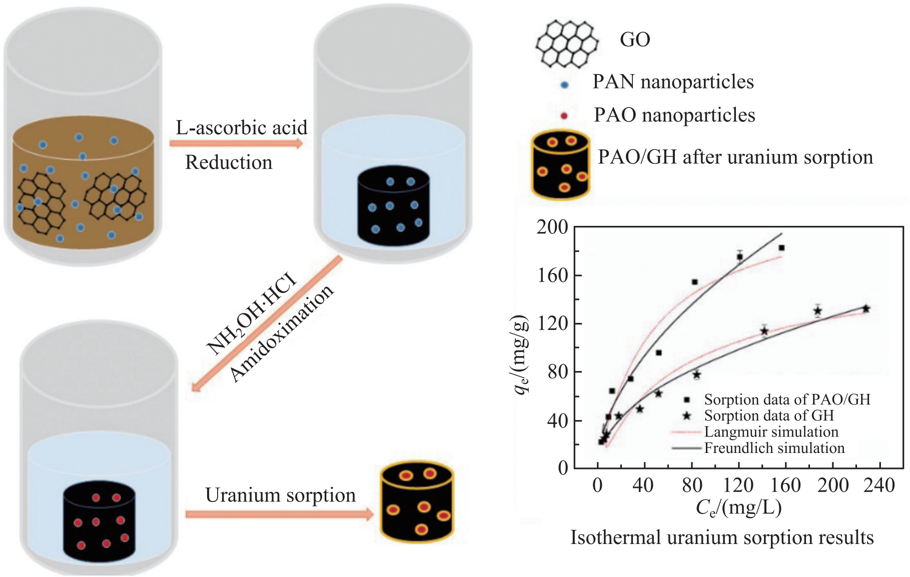
brine by PAO/GH is also performed and the uranium sorption capacity is determined to be 3.5 mg/g, which is higher than the sorbents investigated ever before. Hence, PAO/GH can be used as a potential sorbent for recovering uranium from natural complicated systems.



Isothermal uranium sorption results

Fig. 1 (color online) The fabrication process and uranium sorption property of PAO/GH.

3 - 21 Separation of Actinium-228 from the old Thorium-232 Reagent

Tan Cunmin, Huang Qinggang, Cao Shiwei, Chen Desheng and Qin Zhi

The removal of radioactive actinide from rare earth products is an important task and key technology in the production of rare earth products. That is because element Actinium(Ac) and Lanthanum(La) belong to the same clan in the periodic table. The shell electron arrangement is similar, and the difference between ion radius and atomic radius is small. As a result, their chemical properties are very similar, and it is the most difficult for them to separate from each other. Hence, if the problem of Ac removal in lanthanum oxide is solved, the purification of other rare earth products will be more simple. The reason is that ^{228}Ac belongs to ^{232}Th natural decay system, with half-life of 6.15 h and 100% β decay. The associated γ-ray energy (911.2 keV) and branching ratio ($I\gamma = 25.8\%$) are moderate, which can be directly measured by high-purity germanium gamma detector. The parent material of ^{228}Ac is ^{228}Ra (radium). The half-life of ^{228}Ac and ^{228}Ra are quite different. In two days, the radioactive decay equilibrium can be achieved[1, 2]. Therefore, ^{228}Ac and ^{228}Ra are selected as tracers. In order to study the chemical properties of Ac, this work carried outseparation of Actinium-228 from the old Thorium-232(Th) Reagent (over 30 a).

At first, when Th is coordinated with the complexing agent sulfate ion, the removal of large matrix Th can be realized simply and efficiently through the column separation method. So that the Ac-Racan be loaded on the cation resin, and then eluted to achieve the purpose of separation[3]. After the separation of 1.7 g old thorium nitrate by 2.5 mL cation column, the total recoveries of the three elements are w%(Th) = 94.3%, w%(Ra) = 98.1%, w%(Ac) = 93.9%, respectively. The results of the leaching experiment are shown in Fig. 1(a). The separation of Ac/Ra can be realized through the separation of DGA (diglycolamine) and other resins[4, 5]. The recoveries of ^{228}Ra and ^{228}Ac were 96.3% and 87.4% when the column volume was 2 mL [Fig. 1(b)].

For development the automated separation process, the total amount of Th reagent was increased in next manual experiment. The single treatment capacity of the cation column can reach about 25.6 g of old thorium nitrate and the target of removing large matrix Th can also be achieved completely. The Fig. 2(a) shows that the total recoveries are w%(Th) = 100%, w%(Ra) = 90.5%, w%(Ac) = 91.2%, respectively. After that, a set of automatic separation system device of single column was designed and manufactured. Compared with the manual separation experiment, the removal of Th matrix is almost 100% from 5 g reagent. Ac-Ra crude product can be automatically collected into the end bottle, whose total yield is greater than 90% as shown in Fig. 2(b). It means the material liquid in and out of resin column, leaching and collection process are all be controlled automatically and the systemis feasible in technology.

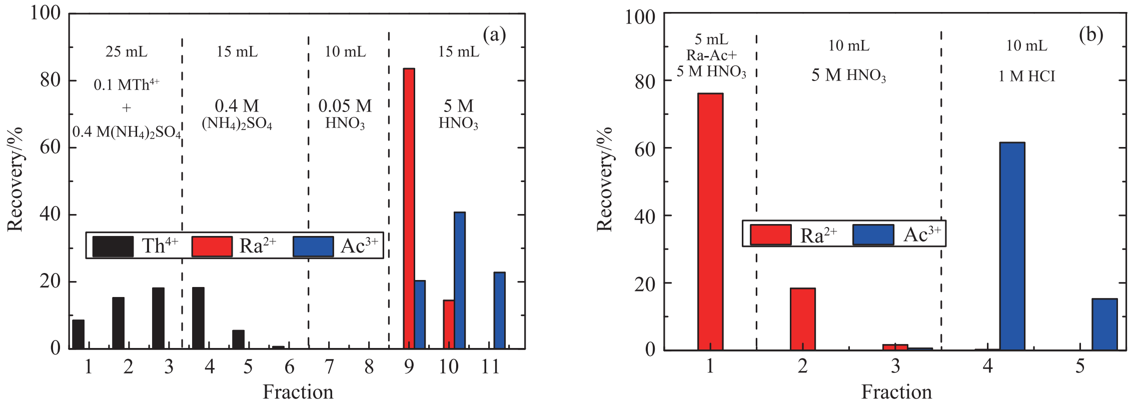


Fig. 1 (color online) Results of manual separation of Th, Ra and Ac from 1.7 g old thorium nitrate reagent: (a) Removal of Th; (b) separation of Ra/Ac.

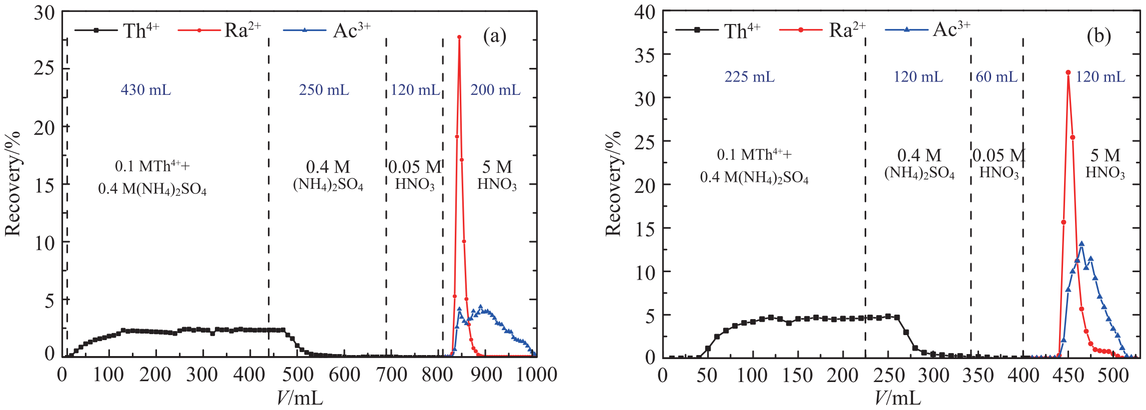


Fig. 2 (color online) Comparative experiment of matrix Th removal by manual experiment ((a), 10 g Th)and automatic system ((b), 5 g Th).

All above experimental results show that ^{228}Ac can be separated from the old ^{232}Th Reagent successfully. And the ^{228}Ac tracers have been successfully applied to the separation of lanthanum and actinides. Some theoretical and technical achievements have been achieved for solving the problem of high radioactivity in rare earth products in China.

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3 - 22 ^{99}Mo production via (p, f) Reaction on Natural Uranium

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^{99m}Tc is the most commonly used diagnostic medical radioisotope because of its short half-life ($T_{1/2}$ = 6.01 h) and low γ-energy (140.5 keV)[1]. Generally, ^{99m}Tc is obtained from ^{99}Mo decays by β-emission. At present, ^{99}Mo is mainly generated from(n, f)reaction in reactor using highly enriched ^{235}U target[2]. However, the reactors would be confronted with the many issues, such as security, technique, overhauling, *etc.* Recently, many alternative routes, *e.g.* neutron generator and accelerator, can produce ^{99}Mo which meet the requirement of nuclear medicine.

In this study, ^{99}Mo was produced by irradiation of natural UO_2 at a proton flux in Superconducting Proton Linac. After irradiation, ^{99}Mo was separated by α-benzoin oxime (α-BO) precipitation from the fission byproducts of uranyl nitrate homogeneous solution. At last, a ^{99m}Tc generator was prepared by adsorbing the purified ^{99}Mo on acid alumina (A-Al_2O_3, *pH* 4~5).