Method for mass tagging SiO_2 with ^{123}I radioisotope

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One of the critical aspects of a radiotracer test is the radiotracer selection. The radiotracer must have compatibility with the investigated phase, and it must follow the studied material without been precipitated or absorbed by the walls. For solid radiotracer phases, two alternatives are possible:
(i) Intrinsic radiotracer: This is direct activation in a small portion of the same material in a nuclear reactor. It is necessary suitable activable elements with favorable concentrations and neutron absorption cross-section in the medium material.
(ii) Surface labeling: a material with physical/chemical characteristics similar to that of the medium material is labeled with a specific radioisotope. The size and the density of the radiotracer must be approximately the same as the non-radioactive particles.
The objective of the present study is to describe the method for mass labeling SiO_2 crystals with ^{123}I.
The labeling process is divided into three steps:
Step 1 – SiO_2 preparation
Chemical cleaning procedures aim to remove the materials deposited on the surface of the SiO_2 crystals. The SiO_2 is washed with distilled water and the lighter fraction in the supernatant is discarded. It was leached with HCl (6M) to remove metals; washed with distilled water, and leached with HNO_3 (6M) to remove organic materials; and washed with distilled water. Chemical etch was carried out with NaOH (0.125M), for 30 minutes; and then washed with distilled water until and dried in a muffle furnace at 120 ºC for 24 hours

Step 2- Preparation of Ag^0–Si Adsorbent
Tollens reagent ($AgNH_3OH^-$) was used to prepare the SiO_2 crystals impregnated with metallic silver (Ag^0–Si)[1]. The SiO_2 prepared in step 2 was deposit in a clean Petri dish, and 7.5 ml of Tollens reagent was sprayed over the SiO_2 crystals. The concentrated formaldehyde was used to reduce the Ag on the SiO_2 crystals. The SiO_2 was transfered to a 100 ml Becker, washed successively with distilled water until there is no residue in the supernatant liquid, and dried in a muffle furnace at 120 ºC for 2 hours.
This procedure provides a permanent and thin silver coating on the individual SiO_2 grains

Step 3 – Labeling Ag^0-Si with ^{123}I
The silver-doped SiO_2 crystals have an excellent performance in capturing iodine in an aqueous solution. [2,3]. The method consists of preparing a glass column filled with Ag^0-Si crystals (5 gr), an aqueous fast pulse with NaI labeled with ^{123}I was injected, and a continuous water flow is pumping through the SiO_2 column.
Figure 1 shows the curves registered by two NaI 1"x1" scintillator detectors, used to estimate the Ag^0-Si labeling process.

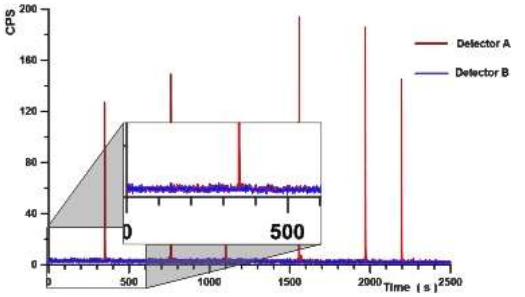

Figure 1: Signal recorded by two scintillator NaI detector placed before and after the column.

The first detector (A) is installed before the glass column and the second after it. Six fast pulses of NaI aqueous solution (1.0 ml) labeled with ^{123}I were injected.
and it is clear that ^{123}I was retained on the Ag^0-Si crystals because detector B didn´t show any signal of the radioiodine. This test shows the high performance of Ag^0-Si in iodine capture, and they were used as a solid radiotracer in industrial applications.

References

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