GAS THERMOCHROMATOGRAPHY FOR ION SOURCE DEVELOPMENT

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The adsorption behaviour of Zn, Rb, As, Ag, In, Cd and Cs on quartz glass surfaces was studied at the new ISOLDE (CERN) gas thermochromatography setup. A high retention of alkali metals and a high volatility of Cd were observed and will be utilised for improved quality of Cd beams at ISOLDE experiments in 2005.

1 INTRODUCTION

In recent years very neutron-rich isotopes of silver (Ag [1]), cadmium (Cd [2]) and indium (In [3]) have been identified by resonant laser ionization at ISOLDE and their half-lives were measured by detection of beta-delayed neutrons. However, detailed βγ spectroscopy is still hampered by the omnipresent background of huge amounts of surface ionized cesium and indium (in the case of Ag and Cd) isobars. In the present study we concentrated on the suitability of fused silica surfaces to retain these elements, which could supplement the selectivity of the resonant laser ionisation by a chemical pre-separation. Earlier studies [4] proposed quartz surfaces for this purpose.

2 EXPERIMENTAL

A new thermochromatographic (TC) setup has been installed at the offline experimental hall at ISOLDE. The setup can be used for gas or vacuum thermochromatography. The addition of a reactive second gas is also possible.

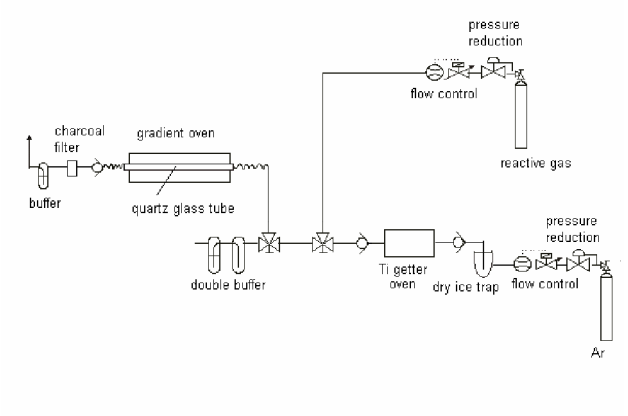

Fig. 1: Setup of the TC experiment at ISOLDE (CERN)

The radiotracers (^{65}Zn, ^{74}As, ^{84}Rb, ^{105}Ag, ^{114m}In, ^{115m}Cd and ^{134,136}Cs) were produced at ISOLDE and implanted into Ta foils. For investigation of non-carrier free Cs, $CsNO_2$ was irradiated at TRIGA Mainz and also applied to Ta foils. The samples were inserted into a quartz glass thermochromatography column of 150 cm length with 6 mm inner diameter. The column was placed into a 10 zone gradient oven with a maximum temperature of 1200 °C. The temperature gradient was approximately linear with 1200 °C/m. The applied gas flow (Ar) varied between 20 and 100 ml /min. The samples were exposed to the temperature gradient for 1h. After cooling, the tubes were scanned with an HPGe detector in steps of 2 cm by use of a Pb collimator. The activity distribution was determined by γ-spectroscopy.

3 RESULTS

All radiotracers except As were released from the sample foils. The alkali metals (Rb and Cs) show a high adsorption enthalpy, probably due to chemical reaction [5]. For Cs, both chemisorption and physisorption occur, and thus several peaks can be observed. As expected, cadmium was barely retained on the quartz glass surface, but remained volatile even below 100 °C. Indium was found to be slightly less volatile on the used surface. Often a second indium peak was observed at lower temperatures, probably corresponding to indium oxide produced from oxygen impurities. Silver shows a medium retention on the quartz glass surface.

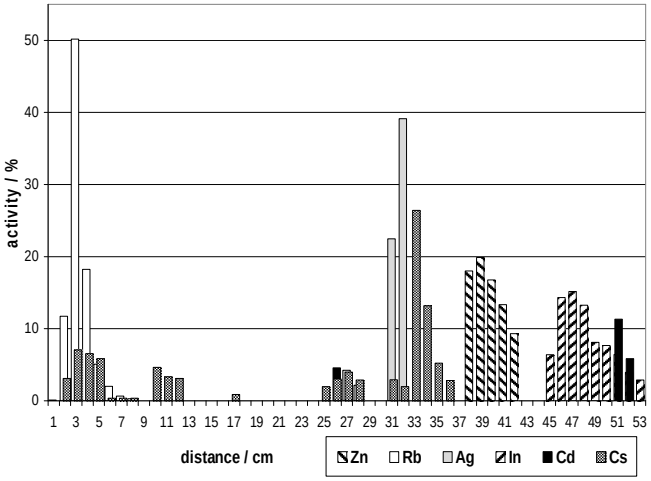

Fig. 2: The deposition of Zn, Rb, As, Ag, In, Cd and Cs on quartz surfaces.

4 OUTLOOK

Due to the obtained results the use of a quartz glass transfer line connecting the target to the resonance ionization laser ion source will be tested at ISOLDE experiments (amongst others at REX-ISOLDE). Hopefully, background from Cs isobars and short-lived In isotopes will be suppressed by a large factor. As silver shows a noticeable adsorption on quartz glass surfaces, other materials for improving the quality of silver beams will be investigated.

5 REFERENCES

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