DEVELOPMENT OF RADIOACTIVE ARSENIC AND GALLIUM BEAMS

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During this reporting period we have continued the development[4] of radioactive arsenic and gallium beams. In seven on-line experiments we have measured yields and ion source efficiencies for several isotopes of these elements using an EBP ion source with either a molten germanium target or a uranium carbide target. The measurements reported here utilized the UNISOR separator and the radioactive atoms were produced with low-intensity proton beams from the tandem accelerator.

The proton-rich radioactive isotopes of arsenic and gallium were produced in a molten germanium target using a fusion-evaporation reaction with 40 MeV protons. The target chamber is constructed of graphite and is 9 mm in diameter and 4 mm thick and contains 1.4 g of germanium. Figure 1 shows the yields of ^{69}As and ^{70}As from the ion source as a function of target temperature. The yields increase with increasing target temperature up to 1450 ^{o}C and then decrease at higher temperatures. The increase is attributable to faster diffusion rates and effusion times that are strongly temperature dependent. The decrease in yields at higher temperatures is due to decreased efficiency of the ion source caused by a high vapor pressure of germanium in the ionization region. The table below gives the measured yields and ion source efficiencies for several isotopes.

Table 1. Summary of measured yields and ion source efficiencies.

Radioactive Beam	Half-life	Target Material	Highest Yield (ions/sec/μA)	Source Efficiency (%)
^{69}As	15.2 m	molten Ge	4.5×10^{7}	0.85
^{70}As	52.6 m	molten Ge	1.1×10^{8}	1.20
^{80}As	15.2 s	UC/RVC	2.0×10^{6}	9.80
^{81}As	33.3 s	UC/RVC	3.6×10^{5}	1.32
^{82}As	19.1 s	UC/RVC	6.2×10^{3}	0.02
^{65}Ga	15.2 m	molten Ge	3.2×10^{6}	0.32
^{66}Ga	9.49 h	molten Ge	2.5×10^{8}	6.36
^{67}Ga	3.26 d	molten Ge	3.5×10^{8}	2.50
^{68}Ga	1.13 h	molten Ge	3.3×10^{8}	8.45
^{74}Ga	8.12 m	UC/RVC	4.5×10^{5}	30.00
^{75}Ga	2.10 m	UC/RVC	5.6×10^{5}	18.20
^{79}Ga	2.85 s	UC/RVC	4.3×10^{5}	23.50

We also have extracted neutron-rich radioactive arsenic and gallium beams from our standard EBP ion source using a uranium carbide target and proton-induced fission.[5] The tandem accelerator provided the low-intensity proton beams (20 nA at 30 MeV) and the UNISOR separator was used to analyze the extracted beams. The target consisted of a thin layer of uranium carbide (~ 12 μm) deposited onto the fibers of a reticulated vitreous carbon matrix. In the range of target temperatures from 1800 °C to 2100 °C the measured yields were relatively constant. The data shown in Table 1 are the highest yields measured for the given isotope.

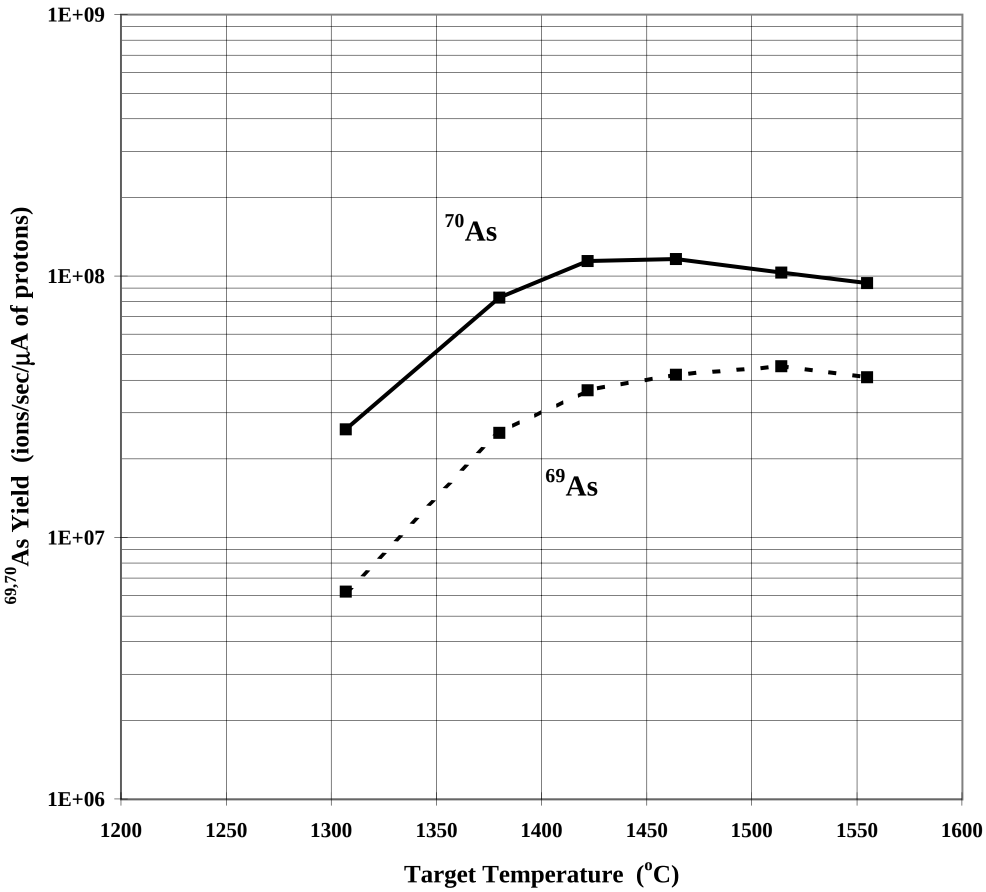

Fig. 1. Yields of ^{69}As and ^{70}As from the ion source as a function of target temperature.

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[4] H. K. Carter, J. Kormicki, D. W. Stracener, J. B. Breitenbach, J. C. Blackmon, M. S. Smith and D. W. Bardayan, *Nucl. Instr. and Meth.* B126, 166 (1997).
[5] See related article in this report.