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Excitation Functions for the Production of ^{81}Rb-^{81m}Kr via the ^{79}Br (α, 2n) ^{81}Rb and the ^{81}Br (^{3}He, 3n) ^{81}Rb Reactious *

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Krypton-81m is said to be an ideal radionuclide for scanning in a large variety of studies of nuclear medicine: To date, most of the ^{81}Rb-^{81m}Kr used in nuclear medical applications has been produced by the following nuclear reactions: ^{85}Rb (p, 5n) ^{81}Sr-^{81}Rb and ^{79}Br (α, 2n) ^{81}Rb. The limitation of the former nuclear reaction is that the required particle energies (68 MeV) are not attainable with the compact medical cyclotron.

Earlier data concerning the latter reaction have been restricted to the measurement of ^{81}Rb-^{81m}Kr and the by-product nuclides such as ^{82m}Rb, ^{83}Rb and ^{84}Rb. In order to determine the optimum irradiation conditions to maximize the yield of ^{81m}Kr and minimize the yields of other radionuclides of krypton, excitation functions and thick target yield curves have been measured by means of the stacked foil technique for α and ^{3}He reactions producing ^{81}Rb-^{81m}Kr, ^{82m}Rb, ^{83}Rb-^{83m}Kr, ^{84}Rb, ^{77}Br and ^{79}Kr, both from potassium bromide.

The ^{79}Br (α, 2n) ^{81}Rb and ^{81}Br (^{3}He, 3n) ^{81}Rb reactions have cross section peaks of 300 mb and 320 mb at 28 MeV and 29 MeV, respectively.

The ^{79}Br (α, 2n) ^{81}Rb-^{81m}Kr reaction will provide satisfactory yield 2 mCi/μAh for most nuclear medical applications. However, the ^{83m}Kr contamination limits the products usefulness in high-resolution nuclear medical applications and the need for 40 MeV particles restricts the production to higher energy cyclotrons.

On the other hand, the ^{81}Br (^{3}He, 3n) ^{81}Rb-^{81m}Kr reaction is particularly advantageous since the ^{83m}Kr contamination can be reduced to an almost negligible. Under our experimental conditions (30 MeV ^{3}He, 1 μA for an hour) about 2 mCi ^{81m}Kr can be produced. This yield is comparable to that for the α reaction. Moreover, the compact cyclotron cannot accelerate α particles to 35 MeV to 40 MeV necessary to produce sufficient ^{81}Rb-^{81m}Kr by the ^{79}Br (α, 2n) ^{81}Rb reaction, whereas the ^{81}Br (^{3}He, 3n) ^{81}Rb reaction needs 30 MeV ^{3}He particles, which is available from some compact cyclotrons. This shown that the ^{3}He bombardment is especially useful if one is limited to use of ^{81m}Kr produced soley by a compact cyclotron, although it has not been reported in the past.

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