

### Production of $^{11}\text{C}$ and $^{13}\text{N}$ Labeled Gases

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$^{11}\text{CO}$ ,  $^{11}\text{CO}_2$  and  $^{13}\text{N}_2$  are well known to be useful for lung function study. They can be, however, used only at medical facilities equipped with cyclotrons because of their short half-lives ( $^{11}\text{C}$ ; 20 min,  $^{13}\text{N}$ ; 10 min). We have investigated a rapid and continuous production method of these radioactive gases by using the NIRS Medical Cyclotron.

A target gas was held constant in the irradiation tube and it flowed out constantly from the tube together with produced radioactive gases, which was then purified by passing through reaction and absorption tubes, followed by analysis with a "on-line" radio-gas chromatograph. Energies of incident protons were 12 MeV and 15 MeV for the  $^{11}\text{C}$  and  $^{13}\text{N}$  production, respectively. A current of proton beams used in this study was 10  $\mu\text{A}$ .

*The  $^{11}\text{CO}$  and  $^{11}\text{CO}_2$  production* The chemical

form of the  $^{11}\text{C}$  produced by the  $^{14}\text{N}(p, \alpha)^{11}\text{C}$  reaction was observed to be chiefly  $^{11}\text{CO}$  and  $^{11}\text{CO}_2$ , and they could be easily changed into either of them by passing through a  $\text{CuO}$  column at  $700^\circ\text{C}$  or a  $\text{Zn}$  column at  $390^\circ\text{C}$  for  $^{11}\text{CO}_2$  or  $^{11}\text{CO}$ , respectively. Radioactive concentrations were 40  $\mu\text{Ci/ml}$  for  $^{11}\text{CO}_2$  and 35  $\mu\text{Ci/ml}$  for  $^{11}\text{CO}$  at a  $\text{N}_2$  flow rate of 100 ml/min. Radiochemical purity was more than 98% and radiochemical contaminants were  $^{11}\text{CH}_4$  and  $^{13}\text{N}_2$ .

*The  $^{13}\text{N}_2$  production* A mixed gas ( $\text{CO}_2$ : 90%,  $\text{He}$ : 10%) was used as a target.  $\text{CO}_2$  was removed with  $\text{NaOH}$  from the target gas after passing through the irradiation tube, and then it contained 130  $\mu\text{Ci}$  of  $^{13}\text{N}_2$  per 1 ml of  $\text{He}$  with more than 99.9% of radiochemical purity. Only  $^{13}\text{N}_2\text{O}$  was found as impurity (less than 1%) which decreased with a longer irradiation.

### Production of High Purity $^{123}\text{I}$ with $^{124}\text{I}$ Contaminant

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The  $^{127}\text{I}(p, 5n)^{123}\text{Xe}(\beta^+, \text{EC}/2.1 \text{ hr.})^{123}\text{I}$  reaction was used with 60 MeV protons to obtain high purity  $^{123}\text{I}$ . About 10 MeV of the proton energy is lost in the target of  $1.5 \text{ g/cm}^2$   $\text{NaI}$  powder. A generator method in a single pass configuration similar to that of Sodd, et al., was used to separate the generated radioactive xenons from the target and a carrier  $\text{He}$  gas.

The  $^{123}\text{I}$  activity recovered from the liquid  $\text{N}_2$  trap was about 15 mCi at  $\sim 7$  hr. after the irradiation of 2.5 hr with 1  $\mu\text{A}$ . Radioactive contami-

nants except  $^{125}\text{I}$  were not detected in the solution after purging with a fresh  $\text{He}$  gas, at a flow rate of 20 ml/min for 5 min and the ratio to that of  $^{123}\text{I}$  was 0.1% at  $\sim 7$  hr, after the end of bombardment. Without this treatment, the eluate from the trap contained about 1%  $^{125}\text{Xe}$  and  $2 \times 10^{-4}$  %  $^{127}\text{Xe}$  in the final solution.

To obtain high purity  $^{123}\text{I}$ , it is essential to treat the trap with a fresh  $\text{He}$  gas or to reflux the solution.