271

DEVELOPMENT OF HIGH YIELD LIQUID TARGET AND $^{13}NH_3$ AUTOMATIC SYNTHESIS SYSTEM.
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When producing ^{13}N-aqueous solution, a useful radioisotope in medical application, by means of a cyclotron, it has so far been impossible to gain such RI yields as expected from theoretical data because the liquid target was heated into boiling when the beam current was excessively increased.

The newly-developed automatic target system produces ^{13}N aqueous soultion at a high yield, withstanding the irradiation (max. 50 μA current) of protons (15 Mev) emitted from the small medical cyclotron (CYPRIS), suppressing target solution heating by forced circulation and cooling and, further, by segregating the gas phase from the liquid phase which have penetrated into the target solution. Also, it was verified that this target system could produce $H^{18}F$, using $H_2{}^{18}O$ as the target solution. In addition, as a result of automatic synthesis of $^{13}NH_3$ using ^{13}N aqueous solution (^{13}NOx) produced by the target system as a starting material, we obtained $^{13}NH_3$ at a radiochemical yield of 70 - 80%.

272

DEVELOPMENT OF $H^{11}CN$ AUTOMATIC SYNTHESIS SYSTEM AND SYNTHESIS OF ^{11}C-OCTYLAMINE FROM $H^{11}CN$.
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$H^{11}CN$ is a basic and essential precursor in the synthesis of ^{11}C-labelled compounds. We have completed an $H^{11}CN$ automatic synthesis system and herein report on the present status of this efficiently operating equipment.

$H^{11}CN$ is produced through the reaction of $^{11}CH_4$ recovered from (N_2 + a few percent H_2) gas target with NH_3, and its reproducibility is substantially affected by the system conditions involved (mainly, the oxygen content, such as O_2, H_2O, etc.) We have completed an automatic synthesis system, which has high yields and is capable of continuous operation. In addition, in order to confirm that the equipment is fully capable of synthesizing ^{11}C-labelled compounds, we attempted to synthesize ^{11}C-octylamine and succeeded in obtaining a radiochemical yield of 39%. This is attributable to a fact that the downstream operation has been eased because the equipment provides $H^{11}CN$ in an anhydrous state. When the small medical cyclotron, CYPRIS, is combined with this $H^{11}CN$ automatic synthesis system, a maximum of 760 mci $H^{11}CN$ can be synthesized as an EOS yield.

273

DEVELOPMENT OF AUTOMATIC SYNTHESIS SYSTEM FOR ^{11}C-ACETIC ACID AND ^{11}C-ETHANOL.
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^{11}C-acetic acid and ^{11}C-ethanol are labelled compounds, expected to be useful in determining in vivo energy and alcohol metabolism. Using a small medical cyclotron, CYPRIS, we attempted to automatically synthesize these compounds. As a result, we obtained ^{11}C-acetic acid and ^{11}C-ethanol in sufficient yields. In addition, we produced an automatic synthesis system on a trial basis and report our results hereunder.

^{11}C-acetic acid is obtained by introducing $^{11}CO_2$ gas which has been concentrated into Grignard reagent (CH_3 MgBr) and by hydrolyzing the products obtained. On the other hand, ^{11}C-ethanol is obtained by introducing $^{11}CO_2$ gas into CH_3 MgBr, and by distilling and hydrolyzing the products obtained after $LiAlH_4$ has been added. Through this process, we obtained 20 - 25 mci of ^{11}C-acetic acid and 20 - 25 mci of ^{11}C-ethanol as EOS yield (CYPRIS: 20-minute irradiation of P-10 μA). Radio gaschromatographic and radio liquid chromatographic analyses indicate that these products have high radiochemical purities.

274

DEVELOPMENT OF ^{11}C-GLUCOSE (PHOTOSYNTHESIS) AUTOMATIC SYNTHESIS SYSTEM.
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^{11}C-glucose has been looked upon as a highly useful labelled compound because it enables the rate of in vivo local metabolism of glucose to be externally measured. We produced a ^{11}C-glucose automatic synthesis system on a trial basis based on the photosynthetic process, and we obtained outstanding test results which we report hereunder.

The $^{11}CO_2$ gas is obtained from the nuclear reaction of $^{14}N(P, \alpha)^{11}C$ and $^{11}CO_2$ is admitted into a photosynthetic reactor containing spinach after being condensed by molecular sieve 5A. Then, ^{11}C-glucose is obtained after extraction, hydrolization, separation and refining. Through this process, the remote-controlled, automatic synthesis system set up in a hot cell produces ^{11}C-glucose sufficient for clinical application. In the synthesis process (60 min) of ^{11}C-glucose using this automatic synthesis system, the rate of recovery from molecular sieve stood at 86%, an intake rate of $^{11}CO_2$ by spinach at 83% and an average ethanol extraction rate at 65%.