SYNTHESES OF BIOLOGICALLY ACTIVE ORGANIC GERMANIUM COMPOUNDS

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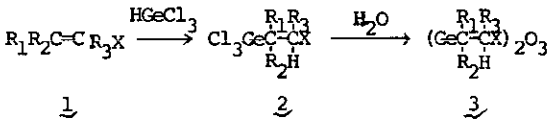
The development of the organic chemistry of germanium has been due in part to the semiconducting nature of the element and to the anticipated similarities in chemical and physical properties. However, no biological activities of the organic germanium compounds have been reported to date. Recently, we have observed that carboxyethylgermanium sesquioxide (Ge-132) (3-i, X=COOH) resulting from the hydrolysis of carboxyethylgermanium trichloride had unique chemical structure like the crown ethers (from X-ray crystallographic analysis) and showed antitumor activity, a IFN inducer, and almost no toxicity.

We wish to report here simple and efficient syntheses of Ge-132 related compounds to develop anticancer drugs as shown in Figure.



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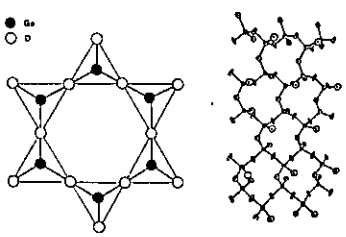

Crystal Structure of Ge-132

	R_1	R_2	R_3
(i)	H	H	H
(ii)	CH_3	H	H
(iii)	H	CH_3	H
(iv)	CH_3	CH_3	H
(v)	CH_3	H	CH_3

The reaction of alkenes (1) with trichlorogermane gave the germyl adducts (2) in high yields. This reaction followed Markovnikov's rule. However, the reaction mechanism probably contains both addition of trichlorogermane and insertion of germanium dichloride to alkenes due to the double equilibrium as follows.

$$HGeCl_3 \rightleftharpoons H^+(GeCl_3)^- \rightleftharpoons HCl + GeCl_2$$

NMR spectra (^1H, ^{13}C) of (2) showed interest behaviours due to the effect of germanium. Treatment with water, (2) hydrolyzed to the sesquioxides (3) in good yields.

The anticancer test of these new compounds are being carried out.