CARBON DEPOSITION ON TARGET IN BEAM BOMBARDING

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Introduction

In nuclear reaction experiments, carbons are frequently deposited gradually on target surface in beam bombarding process, which is considered to be caused by the dissociation of the residual hydro-carbon molecules in vacuum chamber. Even only a slight amount of carbons sometimes give large background as a contamination, so it is hoped that such carbon deposition may be reduced as possible as we can. However, the detail mechanism of carbon deposition by beam irradiation has not been found yet quantitatively.

Therefore, we have carried out some experiments to obtain further information on the following points.

1. What is the main contribution for the dissocation, the heat by the energy loss in the target foil or the direct collision between the beam and molecules?
2. Where are the hydro-carbon molecules dissociated, on the target foil or near the one?
3. What kinds of hydro-carbon molecules are sensitive to the deposition?

Experimental Method and Result

The experiment was carried out by using the 52-MeV proton beam from INS FM-Cyclotron and the 4-MeV one from the Van de Graff accelerator of Tokyo Institute of Technology.

The carbon quantity deposited on the target was measured by detecting the elastically scattered protons from the carbon as well as the target element with magnetic spectrograph or solid state detector.

As the target foil were used Al, Ni, Cu and Au with several kinds of thickness by considering the energy loss and the heat conductivity in the target.

The carbon deposition rate was obtained for each target in various beam intensities.

Figs. 1 and 2 show the results of carbon deposition by 4-MeV protons for the Ni and Au foils, respectively.

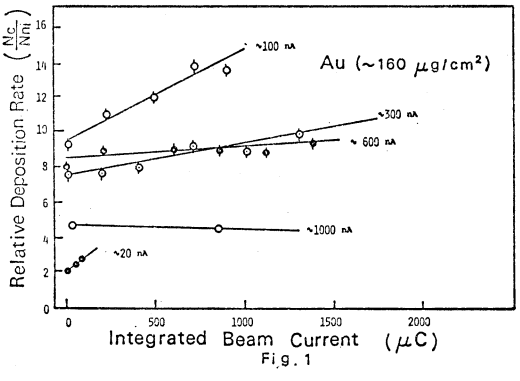

Fig. 1

From the figures it is found that the depositing rates are apparently decreased as increasing the beam intensity. It is also found that although the thickness of the Ni and Au targets are nearly the same, the deposition rate for the Ni is larger than that for the Au in the case of small beam intensity ($\lesssim$100 nA), but it is invented in large intensity (>100 nA).

This phenomenon was not seen for the beam irradiation of 50-MeV protons.

From these results as well as by considering that the heat conduction for Au than Ni is larger it is found that the temperature-up of the target foil caused by beam energy loss has a large sensitivety of carbon deposition.

Fig. 3 shows the distribution of the amounts of the deposited carbons measured by α-ray thickness gauge.

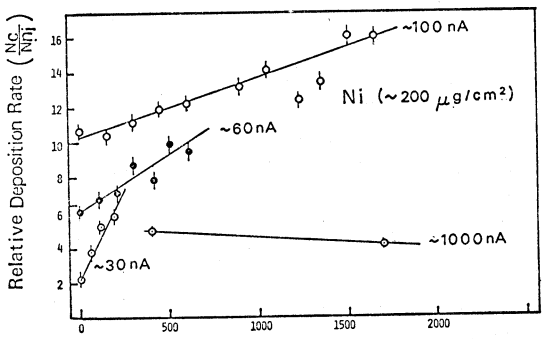

Fig. 2

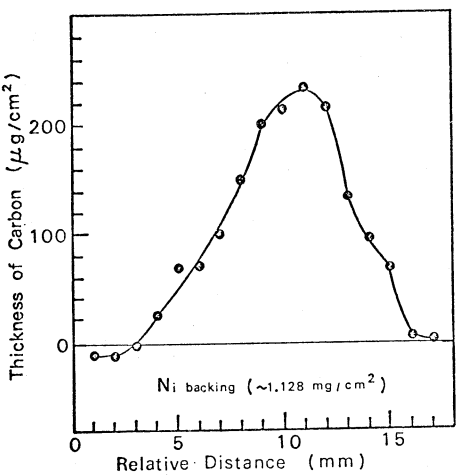

Fig. 3

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