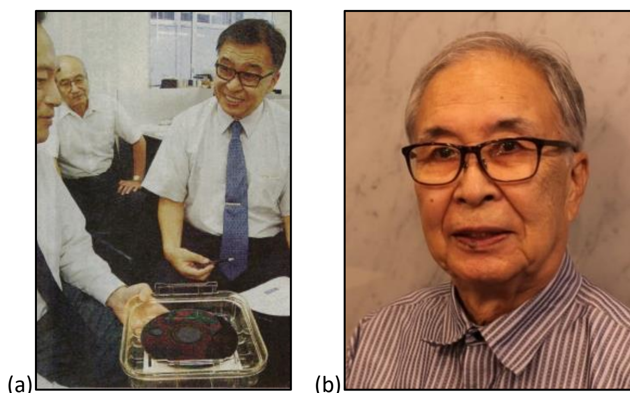

(a) (b)

Fig. 1. Photographs of the inventor of ALE of silicon, dr. Seiichi Iwamatsu, 岩松誠一.

Sources: a) From Asahi Newspaper, Sept. 3, 2004; b) Photograph by K. Kakushima, Tokyo, Oct. 3, 2024.

Abstract **ATOMIC LAYER ETCHING METHOD**

PURPOSE: To etch only one atomic layer on the surface of a substrate accurately, by forming a reactive adsorbed layer on the surface of the substrate, forming a reactive product on the entire surface or part of the substrate by heating or light irradiation, and removing the reactive product.

CONSTITUTION: SiO_2 in the surface of the Si substrate 1 is removed by HF gas in a vacuum container. Thereafter iodine (I_2) is made to be an evaporated gas state, and adsorbed by the surface of the Si substrate at a normal temperature. Thus the adsorbed layer 2 is formed. Then, the substrate is heated to about 100 °C, the Si substrate 1 and the iodine adsorbed layer 2 are reacted, and an Si iodide layer is obtained. Said Si iodide layer is evaporated and removed by the heating of the substrate 1 up to about 300 °C. By the formation and removal of the adsorbed layer, one atomic layer of the surface Si of the Si substrate is removed. By repeating this operation, the etching can be performed at the rate of the thickness of about 4-5 Ångström /operation of the interval of the Si atoms.

Fig. 2. Abstract and front-page drawing from the first patent on ALE by S. Iwamatsu, JPS5898929A (ref. 7).

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