§40. Establishment of Surface Erosion Evaluation Method and the Application to Inner Surface Monitor for Large Fusion Chambers -3

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The first result of our threshold evaluation method was demonstrated with tungsten irradiated by electron beams[1]. This new method to estimate erosion thresholds of various material surfaces with high power pulsed electron beam was extended to the surface erosions with various pulsed laser lights[2]. The highlight of the candidate material in last year was the CVD polycrystalline diamond, especially of the commercial optical grade[3-4]. We compared the endurance strength of the above diamond with the tungsten strength. There was not much difference between the both strengths, which was very attractive for such diamond to be used as parts of various structural materials especially for the plasma facing surfaces of nuclear fusion reactors. In this year, we investigated the possibility to start the various application studies. The preparatory results are described here, together with a poposal of a new IFE chamber scenario[5]. An additional application of the surface diagnostic with the same kind of displacement sensor to the future nuclear fission power reactor was also proposed as one of the spin off researchs from the fusion research works.

There are various kinds of commertial displacement sensors. Triangular optical paths types among them are cheaper and very convenient to measure the material surface conditions, allthough they are weak under the hazardous noise environments. As the optical interference type dislacement sensors are stronger under the very severe noise environments on the contrary, they are suitable for the fusion reactor surface monitors as is shown in Fig. 12 in Reference 1. This is the case of rear side surface profiler.

Two Japanes companies (Keyence Co. Ltd., and Omron Co. Ltd.) were chosen to make test trials of our various samples, because they produced the optical interference type senseors. As the former company had lots of product selection possibilities, we made more access to their poducts than to the products of the latter company. One of the sensor heads suitable for our purpose is shown in Fig. 19 in Reference 2. The head diameter and length were 8mm an 42.3mm, which was connected to the sensor controller with a long (up to 11000mm) thin glass fiber. We tried to measure the thickness of our diamond sample with this sensor (and with shorter fiber connection). As the thickness was about 0.6mm and marginal to be measured correctly, the thinner thickness sample was necessary to advance to the next step

The above diamond samples were the products of Element Six Co. Ltd., and we inported them directly from United Kingdom. Although we orderd a thinner sample, they could not produce for us. Then, we looked for a company which could grind the sample with a special method. There was only one Japanese company in the world. They said that they might try to make a tap with 0.3mm depth and 3mm diameter on the former 0.6mm thick sample. During this search, we found out another company (name was same as above , Element Six Co. Ltd., but in USA), which could supply us the same kind of sample with 0.3mm thickness and 5x5 mm square size. The new sample price was nearly same with the price to grind and get the aboce mentioned tap on the former sample. So that, we ordered a new sample to USA. Now we are waiting for the arrival of the sample at our laboratory.

A different idea to realize the rear side surface monitor was the coating of only one sample surface with anti-reflection film. If the coated side faced to the front side of the displacement sensor, only the uncoated surface was detected with the sensor. With this kind of arrangement, we hoped to measure the surface profile of the uncoated and plasma side surface. We have had already the coated samples (UK version of sample and coated by a Japanese company, Sigma Kohki Co. Ltd.). We will soon make the surface irradiations with various pulsed lasers and particle beams.

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