Anode Layer Linear Ion Source for Roll-to-Roll Process

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Abstract: Korea institute of materials science (KIMS) has researched an anode layer linear ion source (ALIS) for various roll-to-roll treatment processes. The ALIS can be used to Ar ion beam (1~2 keV) treatment, and diamond-like carbon coating and so on. The treatment width of ALIS is 500 mm with a uniformity below 5 % (=(Max-min)/(Max+min)). We also demonstrate the status of development of ALIS in a roll-to-roll industry.

1. Introduction

An ALIS is a promising method to a dry etching process in vacuum. The ALIS can generate uniform linear ion beams with a high energy above 1 keV. Since the discharge emitting ions is independent to etched materials, the ALIS can etch various surfaces without additional modifications. Furthermore the ALIS has advantages such as expandability and simple geometry, easy maintenance. For this reason, we investigate the ALIS for many surface treatment process. The etching performances of various ALIS were presented in this paper.

2. Result and discussion

There are many industrial companies (Advanced Energy (AE), General Plasma Institute (GPi)) to manufacture an ALIS. They have developed ALIS for industrial applications before several tens years ago. Also, Nowadays, they are developing the ALIS to improve a beam extraction efficiency (ion current) and a reduction of electrode erosion. Industrial parts require a high etching rate to adapt the ALIS to high speed roll-to-roll processes. Comparing the etching performances, several ALISs showed different etching performance as follows.

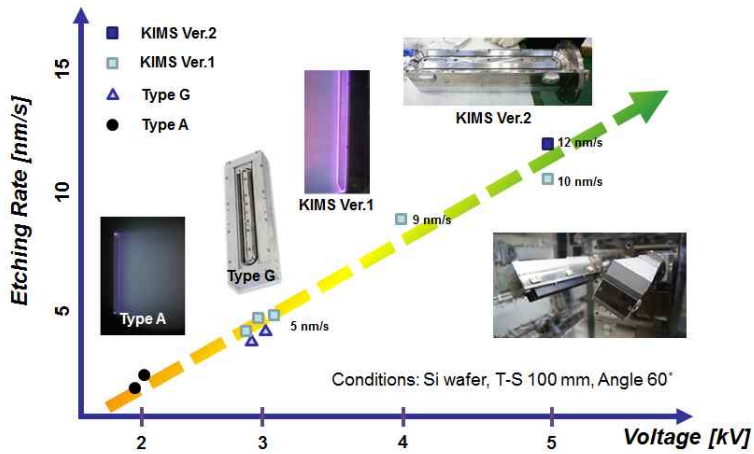

Fig. 1. The status of etching performance of anode layer linear ion source

Figure 1 is the etching rate of Si substrate to evaluate the etching performance of each ALIS, AE, GPi, and KIMS. The ALIS of KIMS showed the best etching result at 5 kV. Another ALIS is difficult to increase a discharge voltage up to 5 kV because of an internal electrical breakdown by a high voltage. The KIMS ALIS also has stability and durability in high voltage (5 kV) discharge operation. Simulation analysis of discharge in ALIS was used to optimize ion beam extraction and the simulation result was in good agreement with practical ion beam etching results.

3. Conclusion

The KIMS ALIS showed the best etching performance comparing with another ALISs. Recently, we are developing the large width ALIS to increase a treatment width up to 1550 mm.