浮遊電極導入大気圧プラズマ源によるガラスエッチング

Etching of glass by floating-wire assisted atmospheric pressure plasma

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1. Introduction

Dry etching of glass is generally exhibited very low etch rates.[1] By using a long floating wire, it is possible to ignite plasma at atmospheric pressure and generate plasma at a remote region.[2,3] Here we have developed a high-density atmospheric pressure inductively coupled plasma that can be remotely generated by placing a 170-mm-long floating wire inside of a discharge tube and flowing Ar gas. Generation of a large-area plasma and an etching of glass are demonstrated by introducing SF_6.

2. Experimental method

The plasma source consisted of a 200-mm-length L-shaped quartz tube with a three-turns Cu coil and a long floating metal wire was placed inside. SF_6 gas was introduced to the remote region, where an Ar plasma blew out from the slit of the L-tube. The plasma was prone to light blue when SF_6 gas was introduced and extended widely over the sample surface. The Ar/SF_6 flow ratio and the very high frequency power were used at 6 slm/250 sccm and 100 W, respectively. The working pressure in the chamber was kept at 0.7 atm, and the substrate was kept at 420 °C. The samples had the size of 15 × 20 × 0.5 mm^3. The etch rate was determined by the etch depth measured by a surface profiler.

3. Results and discussion

Fig. 1(a) show a photograph of the blew-out plasma region with introduction of SF_6. The whole sample area was etched. Fig. 1(b) shows the spatial distribution of etch rates of the quartz glass substrate. The inset image displays a photograph of the etched glass with 8 measured points along the centerline of the sample, which is parallel with the slit of the discharge tube (the transparent parts are masked area before etching). The etch rate was around 1.5-1.7 μm/min over the two-thirds of the whole centerline length. A glass removal rate of 0.3 mm^3/min was estimated. The high-density plasma remotely generated from the L-shaped discharge tube could be developed for high-rate and large-scale glass etching applications.

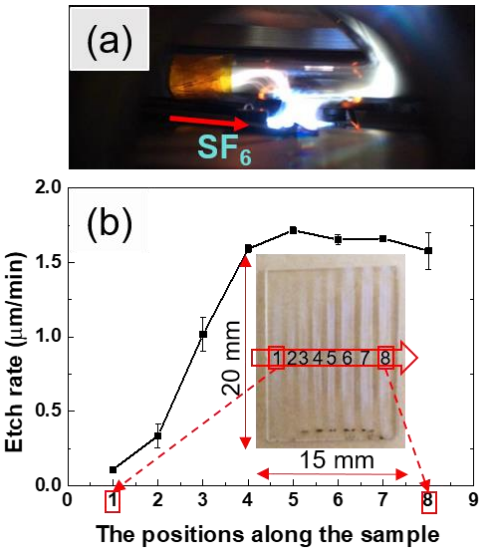

Fig. 1. (a) A photograph of Ar plasma discharge produced from the slit of L-shaped tube with an addition of SF_6 gas at 100 W, (b) the etch rate distribution on quartz substrate.

References

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