

Micro-Plasma Device Utilizing SU-8 Photoresist as a Barrier Rib

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Abstract

A newly designed micro-plasma device using SU-8 photoresist as a barrier rib has been successfully fabricated and characterized. Operating in neon gas at pressures from 300 to 800 Torr and having hexagonal structure, 5x5 arrays of micro-plasma device have been investigated. The driving voltage is lower than 250 V.

1. Introduction

Because of the unique electrical and optical properties, micro-plasma device has, over the past few years, been investigated [1][2]. There are many valuable applications such as the liquid crystal display backlighting, displays, sensors and lighting systems. Unfortunately, the existing micro-plasma device has revealed that dimensional control can not be consistently accurate by drilling method. In addition, such a process is not feasible to make large size arrays. Recently, the semiconductor technology contributes the micro-plasma fabrication to achieve a realm of device possibilities. Furthermore, the low cost assembly of large micro-plasma arrays has been realized.

In this study, we suggest a new process to improve the micro-plasma arrays with photo-definable glass which is incompact enough with the substrate [3]. We utilize the SU-8 photoresist as a barrier rib to fabricate the micro-plasma device. This technology affords the opportunity to realize any geometric pattern by photolithography technique.

2. Experiments

Figure 1 shows the schematic diagram of the micro-plasma device structure in this study. The Si wafer as a substrate is grown on the thermal oxide which has

been adopted as a buffer layer. The electrode is fabricated on the SiO₂ by lift-off process. The width of the gap between each electrode is 20 μ m. After depositing a dielectric layer, the SU-8 photoresist serves as a barrier rib is made on the dielectric layer.

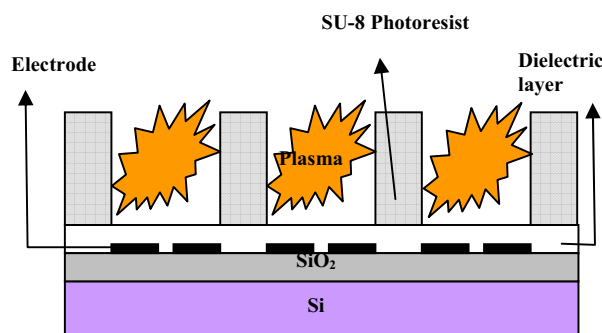


Figure 1. Schematic diagram of the micro-plasma device.

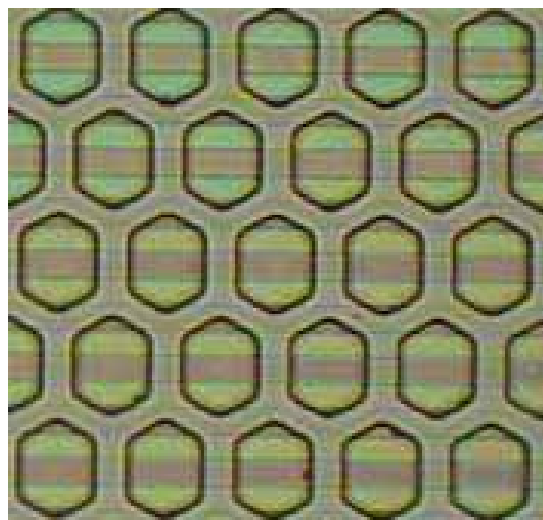


Figure 2. Photograph of the 5x5 arrays of the micro-plasma device with hexagonal structure.

The SU-8 photoresist is spun on the substrate and the geometric pattern is realized by photolithography technique.

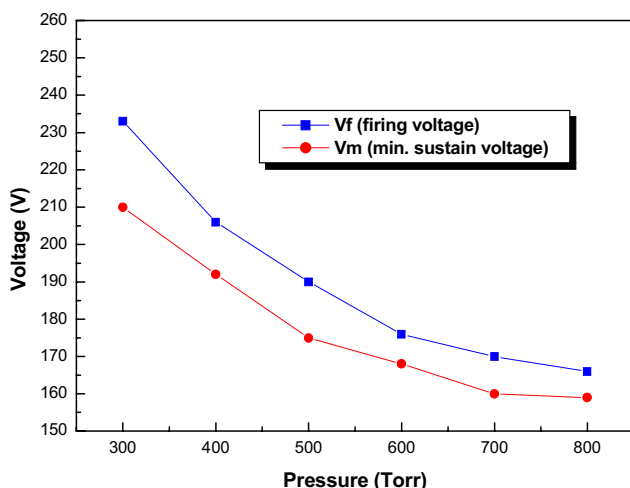


Figure 3. The voltage margin of the firing voltage and the minimum sustain voltage for the micro-plasma arrays with bipolar voltage waveform frequency of 10 kHz at neon pressure from 300 to 800 Torr.

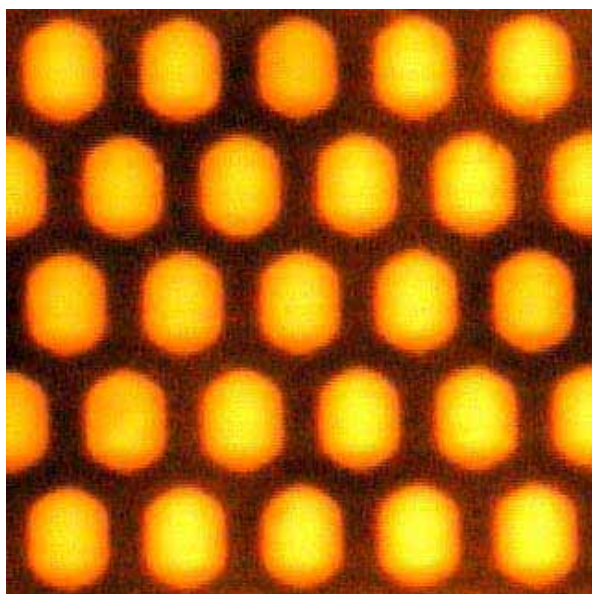


Figure 4. Photograph of the 5x5 arrays of the micro-plasma device with hexagonal structure operating in 300 Torr of neon gas.

3. Results and Discussion

The fabricated device, shown in Figure 2, is investigated in a vacuum chamber. It is operated in neon gas at pressure from 300 to 800 Torr. The voltage margin, the firing voltage (V_f) and the minimum sustain voltage (V_s), for 5x5 arrays operating in neon gas at pressure between 300 and 800 Torr is presented in figure 3. The 5x5 micro-plasma arrays are driven by a bipolar voltage waveform which has the frequency of 10 kHz. It should be noted that the firing voltage reduces by increasing the operating pressure. The glow of the 5x5 arrays, shown in figure 4, is uniform and operating in 300 Torr of neon gas. The firing voltage and frequency are 250 V and 10 kHz, respectively.

4. Conclusion

A micro-plasma device consisting of 5x5 arrays has been operated successfully and reported in this study. Accordingly, there exists a gap in between because of the incompact of photo-definable glass and substrate. This issue will influence individual cells discharging. The micro-plasma device utilizing SU-8 photoresist as a barrier rib exhibits uniform glow discharge and has low firing voltage (lower than 250 V) with bipolar voltage waveform which has a 10 kHz frequency. The firing voltage can be reduced as a function of neon pressure. After operating the micro-plasma device, however, the barrier rib is still well-found. Any geometric or high resolution pattern is feasible and suitable for many valuable applications.

5. Acknowledgements

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6. References

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