

**Development of highly efficient fabrication process of thin film devices
on plastic materials using atmospheric-pressure plasma**

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【Outline of survey】

During the last decades, there has been a steady increase in the utilization of plasma generated at atmospheric pressure. However, the application of atmospheric-pressure plasma seems to be limited to such fields as surface processing and material treatment. Our present study deals with the development of high-rate and low-temperature film growth processes using atmospheric-pressure very high-frequency (VHF) plasma, which is considered to be more appropriate than conventional low-pressure plasma processes for the fabrication of next-generation low-cost and high-performance thin film devices.

The aims of this survey are (1) to develop an electrode system for plasma excitation that can completely remove particulate contamination of the growing films, (2) to achieve high-rate and low-temperature (≤ 100 °C) depositions of good-quality functional thin films, such as microcrystalline silicon ($\mu\text{c-Si}$), silicon dioxide (SiO_2) and silicon nitride (SiN_x), and (3) to fabricate high-performance thin film transistors (TFTs) on plastic materials.

【Expected results】

On the basis of the atmospheric-pressure VHF plasma technology we have already developed for the high-rate deposition of functional thin films at low temperatures, we will realize a dust-free atmospheric-pressure plasma CVD system. Simultaneously, we will study critical deposition parameters to achieve highly efficient deposition processes of $\mu\text{c-Si}$, SiO_2 and SiN_x films having suitable structural and electrical properties for the fabrication of high-performance TFTs, which is very difficult only by improving the conventional low-pressure plasma processes. Consequently, the high potentials of our atmospheric-pressure VHF plasma technology will be demonstrated. The main positive contribution of this survey should be to give a motive force to accelerate practical applications of atmospheric-pressure plasma not only to surface processing but also to thin film fabrication processes.

【References by the principal investigator】

- H. Kakiuchi, H. Ohmi, M. Harada, H. Watanabe, and K. Yasutake, "Low-temperature formation of SiO_2 layers using a two-step atmospheric pressure plasma-enhanced deposition-oxidation process", *Appl. Phys. Lett.* **91**, 161908 (2007).
- H. Kakiuchi, H. Ohmi, and K. Yasutake, "High-Rate and Low-Temperature Film Growth Technology Using Stable Glow Plasma at Atmospheric Pressure", in *Trends in Thin Solid Films Research*, ed. Alyssa R. Jost (Nova Science, New York, 2007), pp. 1–50 (Chapter 1).

【Term of project】 FY2008 – 2012

【Budget allocation】

61,500,000 yen (direct cost)

【Homepage address】

<http://www-ms.prec.eng.osaka-u.ac.jp/toptop.html>