Online LTP Seminar Lecture
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Evolution of Plasma Nanoprocess

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The minimum processing dimensions in the manufacture of large-scale silicon integrated circuits are approaching 2nm, and NAND memory requires microfabrication with a width of 90nm and an aspect ratio of more than 100, and unless the dimensional variation of this processing geometry is minimized, high-performance cell phones will be out of reach. Plasma nanoprocesses are used in more than 80% of large-scale integrated circuit manufacturing, and their evolution is directly related to their contributions to the permanent development of humanity with SDGs. Plasma nanoprocesses can be categorized into top-down processes, mainly etching, and bottom-up processes, such as nanostructure formation using plasma-induced self-assembled growth. Vertically grown nanographene processes, which can be formed by plasma-induced atomic reaction control, can form 3D microfabrication, widths of 2 nm and aspect ratios of 300 or more, structures that exceed those of top-down processes. In other words, there is a need to create advanced nanoprocesses that integrate top-down and bottom-up processes in the future.
This talk will cover the following topics: 1) Advances in the etching nanoprocess of ultrafine organic thin films by controlling radicals and substrate temperature in real time.[1)] 2) Growth of three-dimensional nanostructured thin films (vertically grown nanographene) by plasma-induced self-assembly.[2, 3)] 3) The real-time measurements of atomic reactions between oxygen radicals and two-dimensional graphene.[4)]
Finally, in order to realize these processes, it is important to establish low-temperature plasma process science, which requires the accumulation of databases that incorporate AI. For this purpose, it is necessary to develop measurement science. I would like to advocate the importance of in-situ observation of the synergistic effects of radicals and ions in plasma nanoprocesses and the establishment of a reliable database. In the near future, 3D nanopatterning by plasma nanoprocessing and self-assembly by biomolecules are also expected.

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References

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Masaru Hori was born in Gifu, Japan, in 1958. He received the B.E. and the M. Tech degrees in the Department of Electric Engineering from Waseda University, Tokyo, Japan, in 1981 and 1983, respectively and Ph. D. degree in the Department of Electric Engineering from Nagoya University, Nagoya, Japan, in 1986. In 1986, he joined Toshiba Corporation, Kawasaki, Japan. Since 1992, he has been with the Graduate School of Engineering, Nagoya University, Japan. He became a Research Associate in 1992, an Assistant Professor in 1994, an Associate Professor in 1996, a Researcher, Cavendish Laboratory, University of Cambridge, UK in 1997, and a Professor in 2004. He was a vice director, Plasma Nanotechnology Research Centre, Nagoya University in 2007, a director, Plasma Nanotechnology Research Centre, Nagoya University in 2009, and a director of Plasma Medical Science Global Innovation Centre, Nagoya University in 2013. Since 2019, he has been the Director of Center for Low-temperature Plasma Sciences, Nagoya University.

His current research interests include plasma electronics, plasma processing science in materials and devices, and plasma life sciences to medicine and agriculture.