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Production and Control of Inductively-Coupled Plasmas with Multiple Low-Inductance Antenna Modules for Large-Area and Low-Damage Processes of Next-Generation Devices[1]

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Large-area and low-damage processing of materials is of key importance for fabrication of devices including flat panel displays, thin-film photovoltaic cells and flexible electronics or electronics on polymers. In particular, organic-inorganic hybrid materials are expected as a key materials system for next-generation devices. For successful development of next-generation devices, it is of great significance to develop plasma process technologies capable of reducing plasma damage in order to achieve ultra-fine control of organic-inorganic interface without suffering degradations of organic layer. Furthermore, for enhancement of production efficiency and/or cost reduction in fabrication of these devices, it is significant to develop meters-scale/ultra-large area uniform plasma reactor. In enlargement of source size exceeding a meter, however, plasma distributions hence processing profiles become inherently non-uniform primarily due to non-uniform power deposition profile caused by standing-wave effects. In order to overcome these constraints, plasma generation and control technologies have been developed with low-inductance antenna (LIA) modules to sustain inductively-coupled RF discharge [1,2]. High-density plasma productions to attain plasma densities 10^{11} - 10^{12} cm^{-3} have been demonstrated with simultaneous achievement of reduced sheath-edge potential (as low as or less than 5 eV) and capabilities in active control of the plasma profiles have also been exhibited by adjusting power deposition profiles over large area. Furthermore, plasma-enhanced deposition of silicon films showed low-temperature (200 deg.C) formation of micro-crystalline silicon films due to sufficiently reduced damage during deposition.

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