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Synchronized pulsed plasmas: potential process improvements for patterning technologies

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Since more than 30 years, CW plasmas have been used in the microelectronics industry to pattern the complex stacks of materials involved in IC technologies. However, even if miniaturization challenges have been successfully addressed thanks to plasma patterning technologies, several fundamental limitations of the plasmas remain (ARDE phenomena, differential charging effects, plasma damage) and are limiting our ability to shrink further the device dimensions. In this work, we demonstrate that synchronized pulsed ICP plasmas can improve some of these limitations. In particular, we will demonstrate that profile dependence with aspect ratio can be improved during STI etching and that structural damage in materials can be reduced allowing the integration of ultra-thin layers in devices. These results are well correlated with gas phase analyses of pulsed plasmas and surface analyses of etched surfaces and allow a better understanding of the impact of pulsed conditions on plasma/surface interactions.

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