

Control of the contact hole diameter in $C_4F_6/Ar/O_2/CH_2F_2$ plasmas

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A reduction in the feature size of integrated circuits is critical to achieve dynamic random access memory (DRAM) devices with high density. Optical lithography is widely used to transfer patterns from the mask to the substrate. Due to physical limitations of optical lithography, efforts have been made to overcome its limitation such as double patterning technology, electron-beam lithography, extremely ultra violet lithography, etc. In this work, a novel method to reduce the feature size of a contact hole without lithographical technique is developed.

The sample was a SiO_2 film (2105 nm thick) deposited on a silicon wafer. An amorphous carbon layer (ACL, 553 nm thick) having hole patterns was used as a mask. The diameter of the ACL mask was around 85 nm. Protective layers for reducing the diameter of the ACL mask were firstly deposited on the sidewall of the ACL mask using a $C_4F_6/Ar/CH_2F_2$ plasma. After depositing the protective layer, the contact hole was etched in a $C_4F_6/Ar/O_2/CH_2F_2$ plasma. The diameter of the contact hole was controlled depending on the change in the diameter of the ACL mask. The diameter of the contact hole was successfully reduced to more than 38% of the original diameter of the ACL mask.