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Effect of ion bombardment time on the profile of atomic layer etching

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With the development of microelectronics industry,atomic layer etching increasingly plays an significant role in realizing higher precision control of etching.

In the research, by coupling a one dimensional fluid/MC model with a trenching model, we simulate the ALE cycle in Ar/CF_4 and Ar capacitively coupled plasma, in which four steps are involved. The first step in an Ar/CF_4 plasma is using the F atoms and other radicals to etch the substrate meanwhile fluorocarbon (CF_x) film is deposited in the surface; in the second, purging the residual gas; thirdly utilizing the Ar positive ion to bombarded the fluorocarbon (CF_x) layer in an Ar plasma; the last step is also to remove the residual gas. In our simulation, the ion energy is too low to bombard the substrate in the first step. Using capacitively coupled plasma model of one-dimensional fluid model coupled MC model to calculate the parameter of etching for example the particles density and ion energy distribution, which utilized to simulate the etching profile in the trenching model.

Our results show that the etching profile can be improved with the etching rate increased, by controlling the ion energy and angle distribution as well as the ion bombardment time. Owing to the pressure condition is high relatively, the ion energy tends to be low, and the angle compared to the lower pressure tends to be large. When the aspect ratio is higher, the ion energy and angular distribution will make the wafer notching seriously, so the condition is applicable to a slightly lower aspect ratio.

References

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