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Atomic Layer Etch to Escape Aspect Ratio Dependent Etching-Profile-Selectivity Trade-offs in Plasma Etch ALOK RANJAN, MINGMEI WANG, SONAM SHERPA, TEL Technology Center, America, LLC, PETER VENTZEK, Tokyo Electron America, Inc. — Minimizing each of aspect ratio dependent etching (ARDE), profile, selectivity, uniformity are met by trading off one requirement against another. The problem of trade-offs is especially critical at $<$ 10nm technology. Self-limiting processes like atomic layer etching (ALE) promise a way to escape the trade-offs. Industrial implementation of ALE has not occurred due to speed and precision loss from improper balance of self-limiting passivation and its removal. In recent years strides have been made primarily through temporal and/or spatial pulsing. Moderate success has been reported with some of the trade-offs purported to be managed. Difficulty meeting requirements is due to the inability to control ion energy at low and precise values. We overcome many of the practical implementation issues associated with ALE by precise passivation process control. Very low plasma potential, high radical flux and high bombardment flux are indispensable for achieving ALE. We demonstrate that ALE can achieve zero ARDE and infinite selectivity. Experimental results will highlight that careful consideration of surface processes is required to achieve ALE and not simply "slow etching." Profile control will be shown to rely on careful management of the ion energies and angles. Experimental results are compared with simulation results generated using MCFPM [1] and theoretical scaling models to provide context to the work.

[1] M. Wang and M. J. Kushner, J. Appl. Phys., 107, 023308 (2010)

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