



Optimizing Tools for ALD and ALE

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Both etching and deposition have entered the era of atomic scale processing with the advent of atomic layer etching (ALE) to complement well established atomic layer deposition (ALD) processes. Having spent decades increasing etch and deposition rates up to many micrometers per minute in the case of deep silicon etching, there is now an increasing need to reduce damage at critical interfaces in etching, which is driving the development of very gentle etch processes. ALD is further down the maturity curve, and the driver there has become economics and productivity, although new technical achievements are still prominent in that field.

The different styles of thermal and plasma processes are described. Some processes are self-limiting in one or both parts of the adsorb/react cycle. Some cyclical processes are not self-limiting, but may still be useful.

The impact of atomic layer processing on tool design will be described. Atomic layer processing puts new demands on the processing tools, both controlling very short process steps and for better management of chamber memory, as well as the use of new some input precursors. In situ metrology has been shown to be very useful to monitor chamber state and optimize process development.