Etching of Semiconductor Devices

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Plasma etching or Reactive IonEtching (RIE) is the workhorse for patterning of semiconductor devices sincethe early 1980-ies when it replaced wet etching in manufacturing. Today, RIE isreaching levels of performance which were unimaginable back then. At the sametime, etching technologies such as Atomic Layer Etching (ALE), radical, dry vaporand Ion Beam Etching are finding their way into manufacturing for certainapplications.

In this review, we present anoverview of dry etching technologies used in semiconductor manufacturing. Theemphasis is on the elementary surface processes and how they impact theperformance on the wafer. We will start from less complex etching technologieswhich use just one kind of etching species, such as neutrals, radicals or ions.Then we combine these techniques into cycling processes which leads to thediscussion of ALE.

ALE transitioned to manufacturingbecause of unique performance benefits which come from self-saturation of thesteps and the use of very low ion energies or just thermal means to removematerial. The former property gives uniformity across all lengths scales on thewafer. Low ARDE and surface smoothness are the most attractive features. Lowlevel removal energies deliver selectivity which is a key requirement foretching with atomic scale fidelity.

The highest level of complexityis reached in RIE with simultaneous species fluxes. Reactor designs for thevarious etching technologies and process control will be covered. Finally, andoutlook into the future of semiconductor device etching will be given.

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