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Mechanism for Plasma Etching of Shallow Trench Isolation Features in an Inductively Coupled Plasma ANKUR AGARWAL, SHAHID RAUF, JIM HE, JINHAN CHOI, KEN COLLINS, Applied Materials Inc. — Plasma etching for microelectronics fabrication is facing extreme challenges as processes are developed for advanced technological nodes. As device sizes shrink, control of shallow trench isolation (STI) features become more important in both logic and memory devices. Halogen-based inductively coupled plasmas in a pressure range of 20 – 60 mTorr are typically used to etch STI features. The need for improved performance and shorter development cycles are placing greater emphasis on understanding the underlying mechanisms to meet process specifications. In this work, a surface mechanism for STI etch process will be discussed that couples a fundamental plasma model to experimental etch process measurements. This model utilizes ion/neutral fluxes and energy distributions calculated using the Hybrid Plasma Equipment Model. Experiments are for blanket Si wafers in a $Cl_2/HBr/O_2/N_2$ plasma over a range of pressures, bias powers, and flow rates of feedstock gases. We found that kinetic treatment of electron transport was critical to achieve good agreement with experiments. The calibrated plasma model is then coupled to a string-based feature scale model to quantify the effect of varying process parameters on the etch profile. We found that the operating parameters strongly influence critical dimensions but have only a subtle impact on the etch depths.

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