QDB: A new database of plasma chemistries and reactions – concept and exemplar verification.

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Research objectives

A key goal of the presented research project PowerBase is to produce new integration schemes which enable the manufacturability of 3D integrated power smart systems with high precision through-silicon via etched features. The necessary high aspect ratio etch is performed via the BOSCH process. Investigations in industrial research often use trial and improvement experimental methods. Simulations provide an alternative way to study the influence of external parameters on the final product, whilst also giving insights into the physical processes.

Effect of Chemistry Variation on Polymer Deposition in a C₄F₈ ICP

As an example for the effect of the chemistry on process relevant parameters, we compare the deposition rate of polymers on a blank silicon wafer in a C₄F₈ discharge, we compare a case with neglected 3-body collision (1) and one with high rate coefficients for these reactions on the order of 10¹³ cm⁻³ s⁻¹ when treated as two-body collisions (2).

Current reactor scale validation results

The reactor scale models were developed separately for etch and deposition steps. The validation was performed using experimental data available from the tool manufacturer on blanket wafer etch and deposition. Surface chemistry was constructed for a fixed wafer temperature in both models and pressure, power and flow variations in the models were performed.

The next step outlook

Current data validated models of etch and deposition steps in the BOSCH process for TSV generate angular and energy distributions on the wafer and then used in a consecutive feature scale modelling of the TSV. A variation of the reactor scale parameters around the process recipe will be used to identify optimum combination. The criteria in choosing an optimum parameter set are: best achievable uniformity over the entire wafer; less scallops (or smoother); layer thickness uniformity over the entire TSV height; rounded corners at bottom.