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Diamond deposition domain in the presence of dopants in the gas phase

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Diamond deposition domain in the presence of dopants in the gas phase

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ABSTRACT:

In this presentation, we discuss steady state gas phase computations for predicting diamond deposition in the presence of dopants [1]. This is accomplished using a procedure developed earlier [2] and is applied to gas phase compositions that include sulfur species. The steady state gas phase compositions were performed using CHEMKIN III using a compiled reaction set that includes 216 elementary reactions and 41 C-H-O-S species at diamond growth temperature of 1150 K.

The analysis of the above zero dimensional modeling results using ternary plots suggested that the sulfur addition to the gas phase expands the range of C-H-O feedstock gas ratios for diamond deposition to occur. Specifically, the Sulfur addition to feed gas compositions from the no-growth domain causes an increase in carbon super saturation. Similarly, the sulfur addition to feed gas compositions from non-diamond domain causes a decrease in the super saturation. The model predictions are tested experimentally using hydrogen sulfide as a precursor for sulfur in a hot filament CVD reactor.

In addition, this type of modeling and analysis is essential for guiding the experimental work on diamond deposition inside high aspect ratio vias in silicon substrates. The model predictions using C-H-O feed gas compositions for diamond deposition inside high aspect ratio vias and the corresponding experimental results will also be discussed.

References:

1.G. Bhimarasetti and M. K. Sunkara, The process window for diamond deposition from the vapor phase with sulfur in the C-H-O feed gas mixtures, Thin Solid Films, Accepted (2003).
2. S. C. Eaton and M.K. Sunkara, Construction of a new C-H-O ternary diagram for diamond deposition from the vapor phase, Diamond and Related Materials, 9, 1320 (2000).

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