Computation of three-dimensional flow and thermal fields in a model horizontal chemical vapor deposition reactor

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Abstract

A detailed computational study is carried out to investigate the effects of Grashof (Gr) and
Reynolds (Re) numbers on the three-dimensional (3-D) flow structures and heat transfer
characteristics in a horizontal chemical vapor deposition (CVD) reactor with a circular heated
disk which simulates a 12-inch wafer. The Grashof number is varied from 8.13 × 104 to 813
and the Reynolds number is from 100 to 25. For the range of parameters studied, both the
transverse (return flow) and longitudinal rolls are observed to appear in three-dimensional.
Computed flow structures and heat flux distributions suggest that for constant Grashof
number condition the size and location of longitudinal rolls have direct impact on the
homogeneity of deposition, while the size and location of transverse rolls have a minor effect
on the heat flux and hence on the deposition rate. In addition, the effect of Reynolds number
on the averaged heat flux is negligible under a fixed Grashof number condition. The
buoyancy-to-inertia ratio is found to play an effective role in retarding the formation of
transverse and longitudinal rolls.

Keyword：A1. Computer simulation; A1. Convection; A1. Fluid flow; A3. MOCVD