Simulation Of Gas Flow And Multicomponent Diffusion In A Single Wafer Silicon Epitaxy Reactor

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Abstract

Silicon epitaxy (EPI) is an important process in semiconductor industry. We investigate the gas flow and gas composition in a complex 3D EPI reactor using the COMSOL's Laminar Flow, coupled with Transport of Concentrated Species, as well as the gas mixture properties provided by the COMSOL's Thermodynamics functionality. The gas mixture consists of hydrogen (H_2) and trichlorosilane (TCS, $SiHCl_3$) from different inlets with a spatially varying concentration above a rotating wafer. Simulating the 3D flow fields (figure 1) and gas compositions and visualising them in COMSOL by 2D cut planes and streamlines is the first step towards gaining an in-depth understanding of the process and optimising it for better homogeneity of the grown layer thickness.
We are currently adding radiative, convective and conductive heat transport, using the COMSOL Heat Module, and we plan to include surface chemistry in the future. This will result in a complete multiphysics model - a digital twin - of the Si-EPI process.

Figures used in the abstract

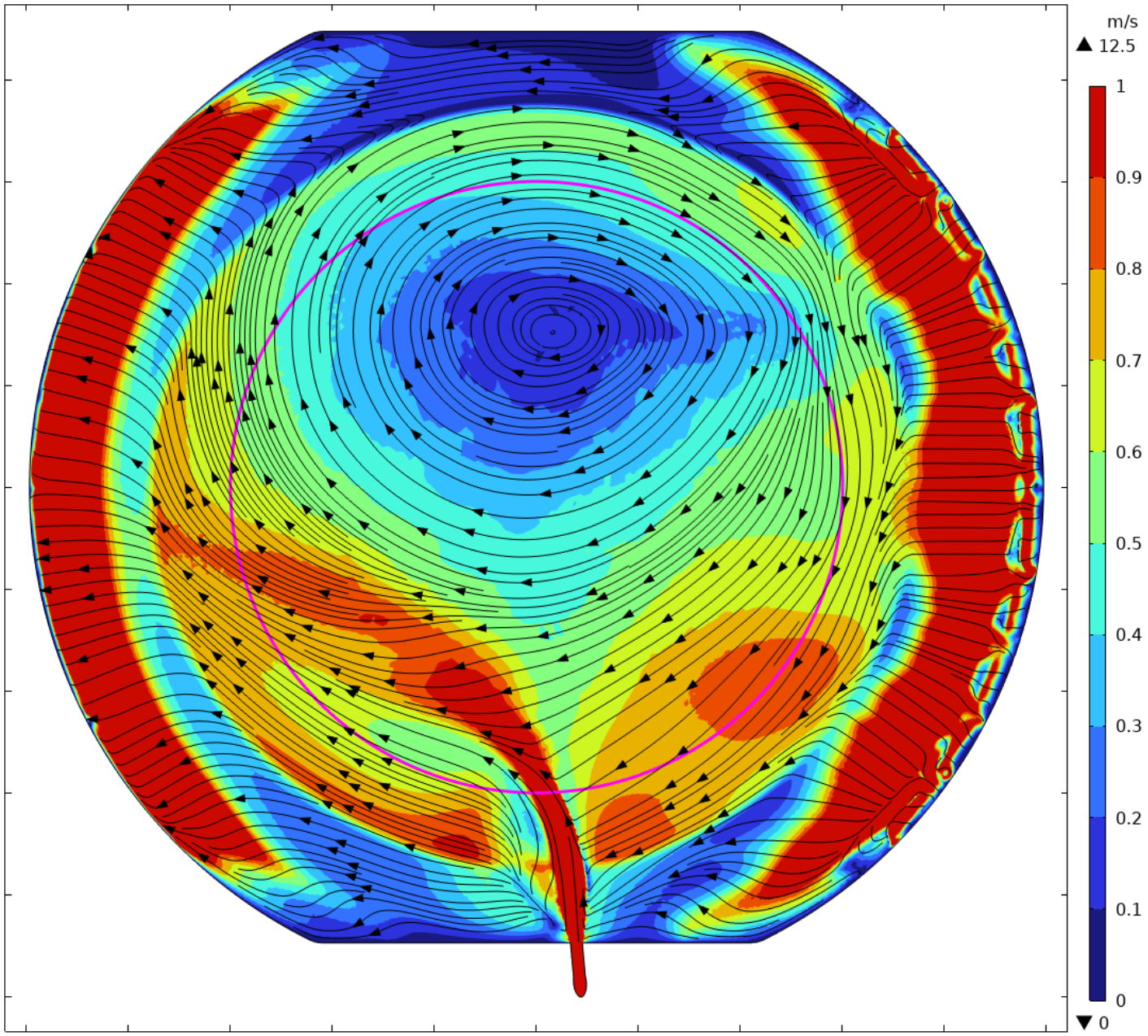

Figure 1 : Gas velocity distribution above a rotating wafer in a Si-EPI reactor with crossflow.

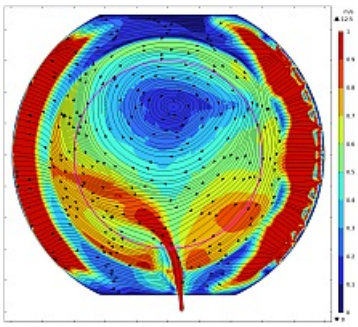

Figure 2 : Gas velocity distribution above a rotating wafer in a Si-EPI reactor with crossflow.