Optimizing hole distribution in a showerhead of a semiconductor reactor

Supraja Shinde[1]

Department of Aerospace Engineering MIT ADT University Loni Kalbhor, Pune, Maharashtra

Guides:

Dr Ajit Balakrishna

Sr. Director, CAE PMTS at Applied Materials, USA.

Prof. Himani Garg

Assistant Professor, Lund University, Sweden.

Prof. Raghvendra Gupta

Professor at Indian Institute of Technology, Guwahati

Mentor: Mr. Manjil Sitoula

FOSSEE IIT Bombay

Abstract

This study presents a computational investigation aimed at optimizing the showerhead design in a Halogen Chemical Vapor Deposition (HCVD) reactor using OpenFOAM. The work focuses on enhancing gas flow uniformity across the substrate, which is essential for achieving high-quality and uniform thin-film deposition. Various geometric configurations were examined, including logarithmic hole distribution patterns in the showerhead and different baffle sizes (8 mm and 16 mm). Simulation results demonstrated that while the inclusion of a showerhead improves gas redistribution, it does not fully mitigate the dominance of central jet impingement. However, increasing the baffle size from 8 mm to 16 mm significantly reduced jet intensity at the centre and promoted more effective lateral flow spreading across the substrate. These findings highlight the critical role of geometric optimization in improving flow uniformity.

Keywords: Chemical Vapour Deposition, Showerhead, Substrate, Baffle.

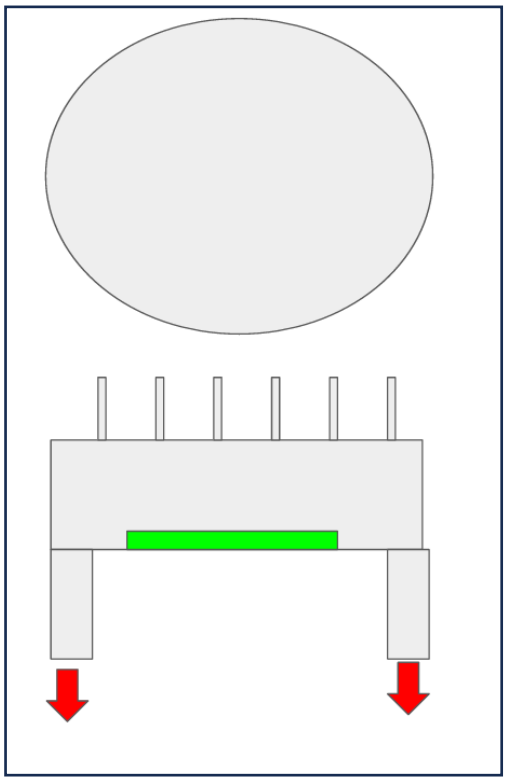

Fig 1: Schematic of the wafer and showerhead

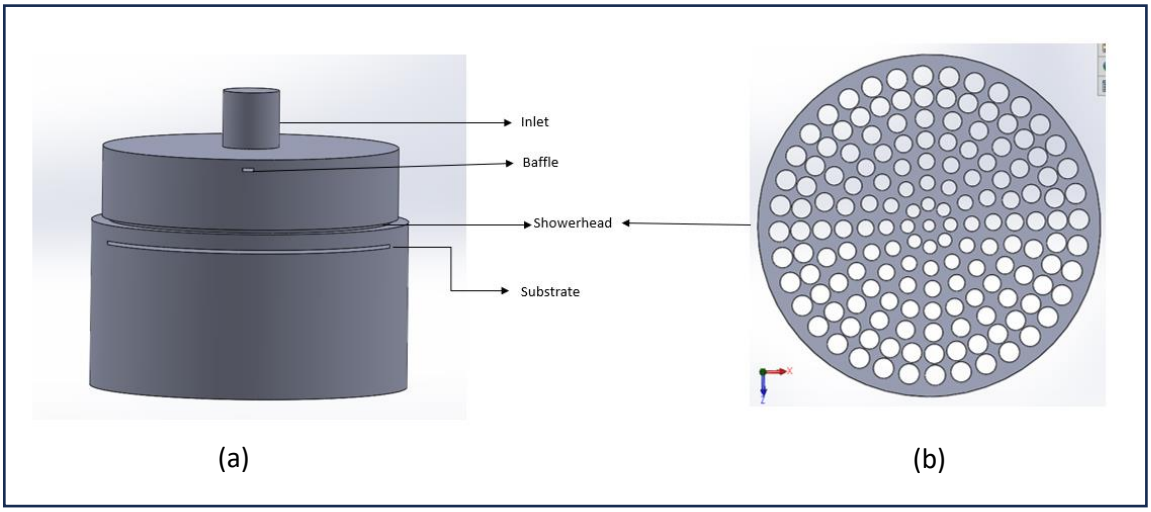

Fig. 2:(a) Computational Domain of the 3D Halogen Chemical Vapor Deposition (HCVD) Chamber(b)Showerhead (i=4)