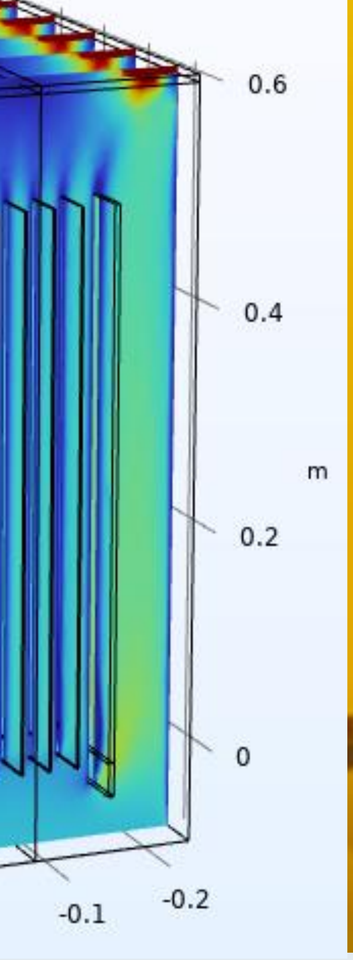

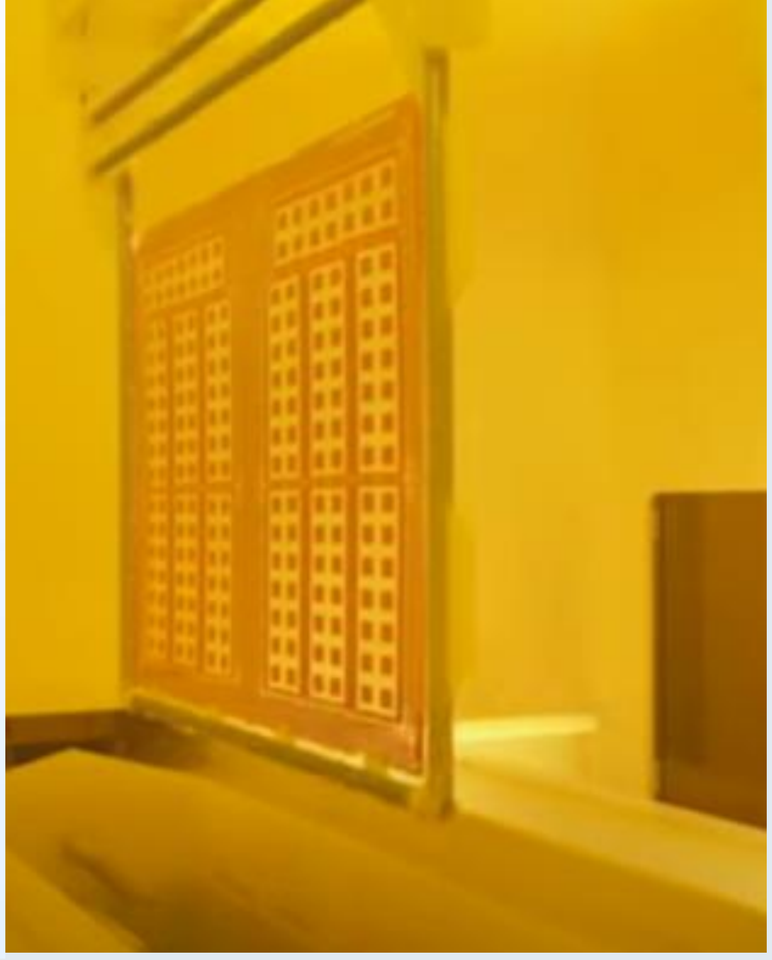

Processing Tank Flow Mechanics and Design for Next Generation Advanced Chip Scale Packaging

Optimize Electroless Deposition on Glass Panels and Overflow Tank processes by analyzing flow distribution uniformity and its impact on Copper flux using COMSOL CFD, Porous Flow and Electrodeposition Modules

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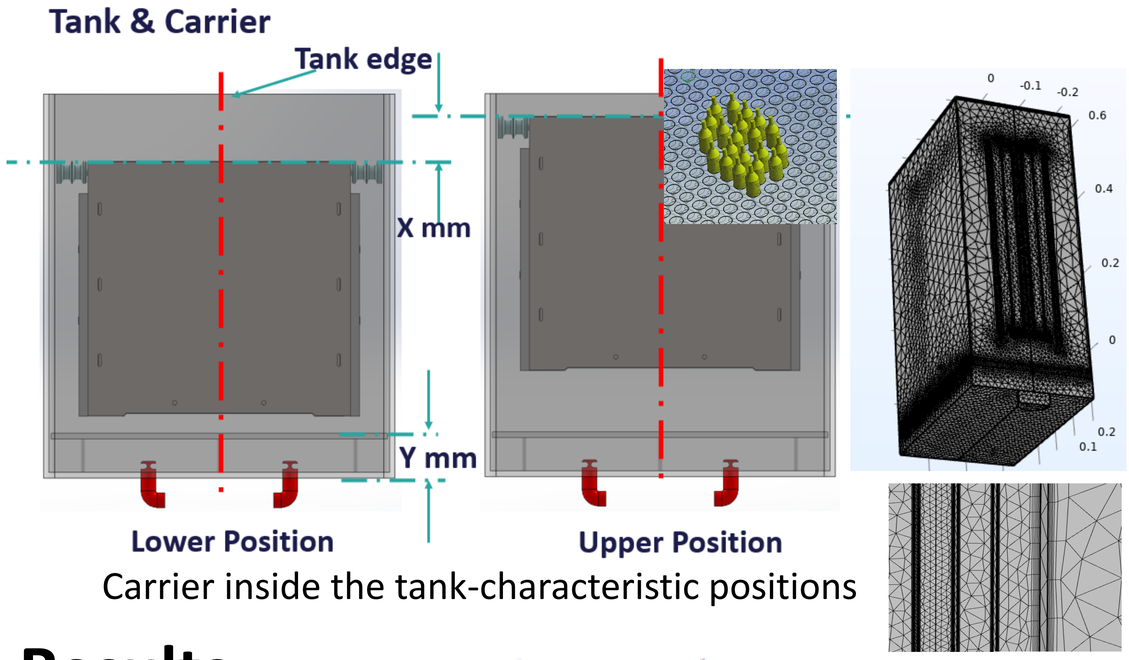
ABSTRACT

Experts in the industry see glass substrates as a promising alternative material for interposers, particularly for heterogeneous packaging such as 2.5D or 3D packages [1]. Recently, Intel revealed that they have developed one of the industry's first substrates specifically tailored for the advanced packaging of the next generation. Using Through-Glass Vias (TGV) on glass panels is a crucial technique for creating 2.5D/3D packaging solutions. Glass substrates offer advantages such as rigidity, flatness and thermal stability, enabling a tenfold increase in interconnect density[2]. We focus on optimizing wet tank processes to achieve the best planar uniformity using CFD and linking it to Electrochemistry – electroless process simulation. Our design approach estimates the velocity flow field (U, V, P) in the sparger tank to be as uniform and unidirectional as possible, particularly in the areas between the panels. We design the individual tank and carrier components to avoid the formation of stagnation zones or zones with backflow. This design ensures shorter residence times, which are critical for the effectiveness of the sprayer system. The convective process leads to boundary layer formation, while diffusion across the boundary layer determines the access of fresh precursors to the surface.

METHODOLOGY

1. Develop 3D electrochemistry model for Cu deposition in a single slot between two panels. Use COMSOL Demo Model [3].
2. Develop various models for liquid flow in an overflow tank and study trade-offs in liquid flow velocity uniformity
3. Incorporate Electroless model (1) with the full tank model (2) and study the effects of fluid mechanics on Cu deposition uniformity

Two types of sparger tanks exist: the Piping-Sprayer (PS) and Perforated-Plate-Sprayer (PS). Both configurations are considered in our analyses, with the perforated plate simulated using the Porous Media module and Darcy-Forchheimer approximation.



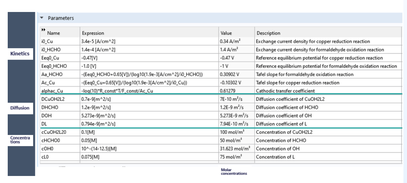
Carrier inside the tank-characteristic positions

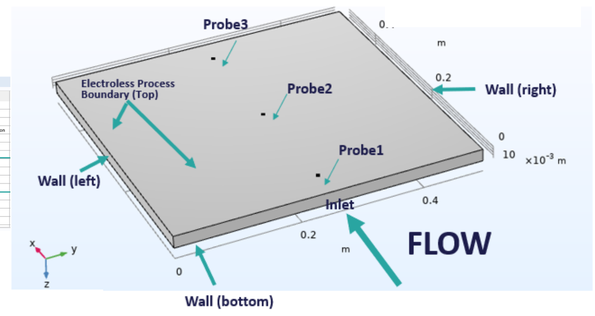
Results

Porous Resistance

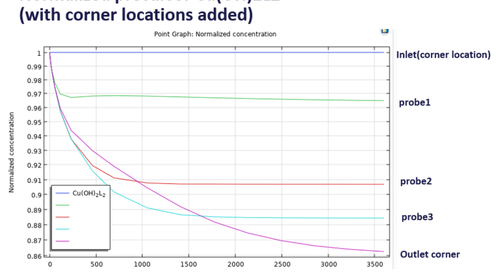
$$\Delta P = \frac{\mu}{K} \cdot U + \frac{\rho}{K_f} \cdot U$$

	K	Kf
Design A	1.17e-8	16, 752
Design B	3. 3e-8	16, 180
Design C	2.83e-9	178,309



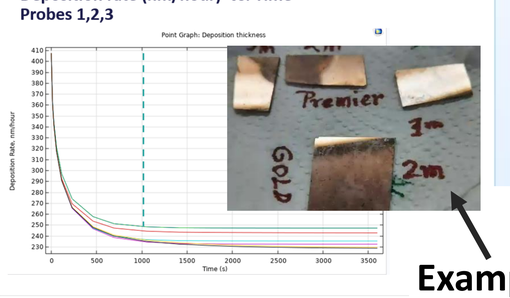


Normalized precursor Cu(OH)2L2 (with corner locations added)

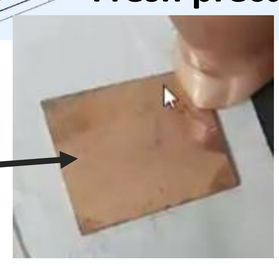


-Predicted dep rates match experimental data

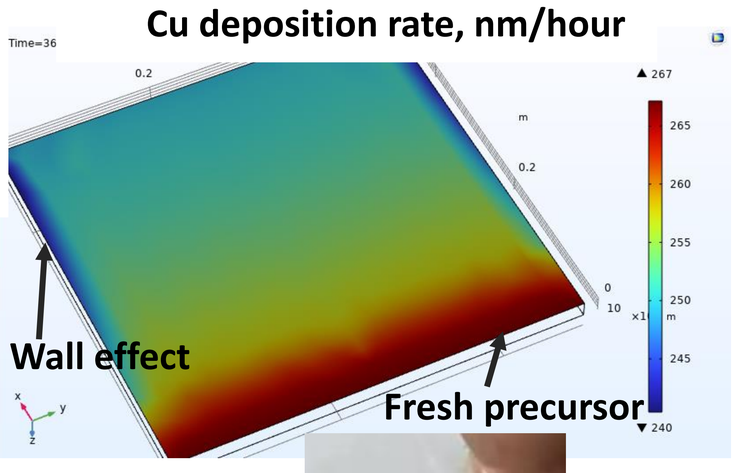
Deposition rate (nm/hour) vs. Time Probes 1,2,3



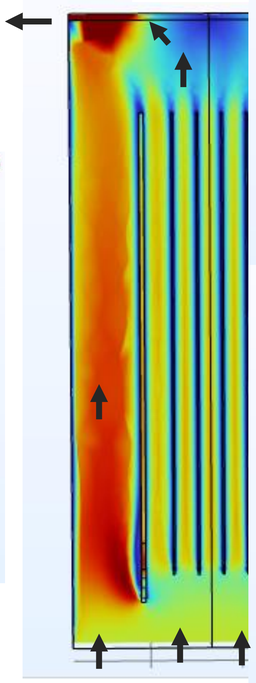
Examples of deposited Cu Thin Films

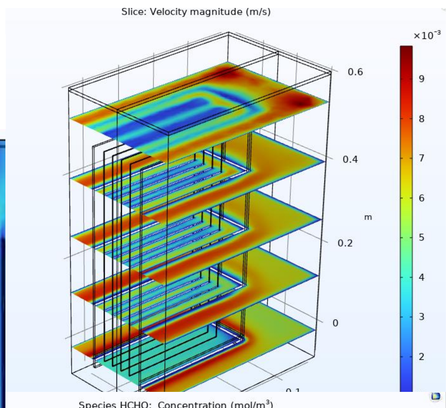


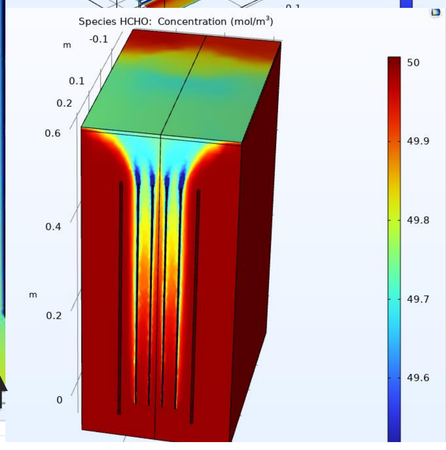
Cu deposition rate, nm/hour



Outlet







Flow Uniformity

Precursor concentration

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2. ***Babak Sabi, Intel senior vice president and general manager of Assembly and Test Development, Glass Substrates*** *explained in 60seconds, https://www.intel.com/content/www/us/en/newsroom/news/intel-unveils-industry-leading-glass-substrates.html#gs.4kwmb5*
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http://yes.tech