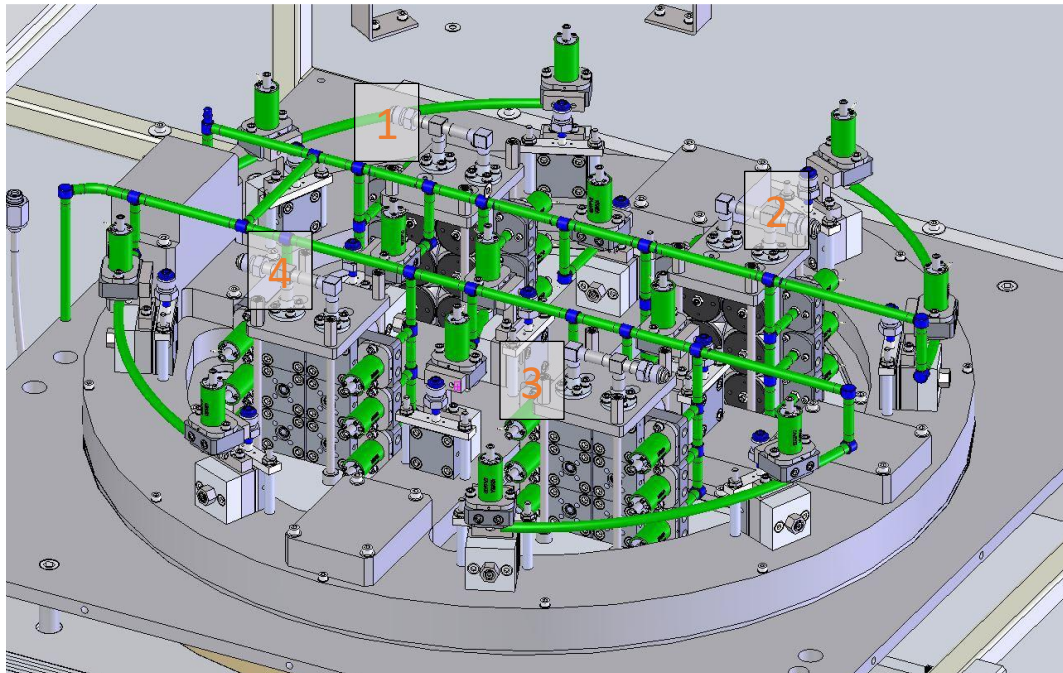


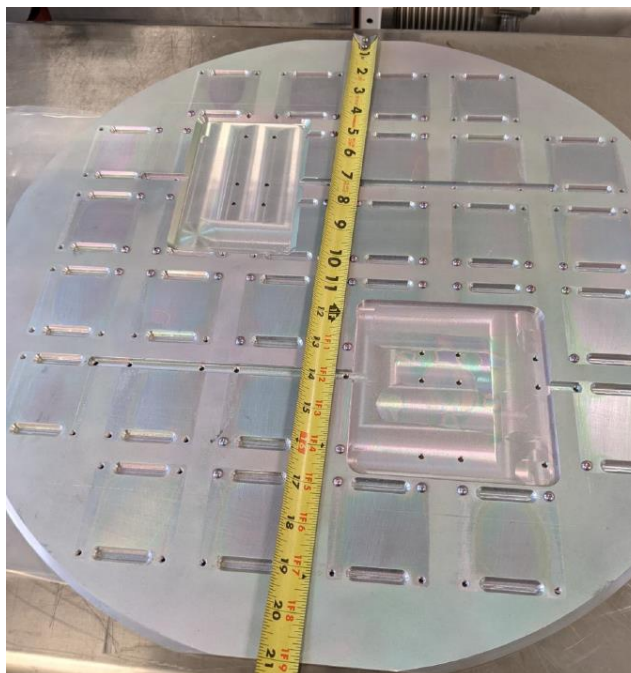
# Fast and Efficient Large Format ALD

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**Figure 1:** Image of the scaled precursor delivery manifold, made of four individual precursor delivery valve stacks, to enable fast and efficient large format ALD.



**Figure 2:** Image of a sample carrier for ALD deposition in the large format ALD tool to highlight the usable area for deposition. The diameter is approximately 525mm.



**Table 1:** Comparison of process parameters and film properties between the standard 200mm and large format 525mm tools at 125°C. Note that the CRISP conversion half-cycle used in the SiO<sub>2</sub> ALD process is a proprietary process. The CRISP process uses a non-metal catalyst to facilitate Si-O bond formation.

Process	Growth per cycle (Å/cy)	Thickness uniformity (% full range)	525mm time per cycle (s)	Time per 100nm comparison (min)	Refractive Index (633nm)	Extinction coefficient (633nm)
Al <sub>2</sub> O <sub>3</sub> TMA/H <sub>2</sub> O	0.94	5.0	2.25	7 minutes longer (40 total)	1.59	0.00
TiO <sub>2</sub> TiCl <sub>4</sub> /H <sub>2</sub> O	0.54	5.0	2.5	5 minutes shorter (78 total)	2.44	0.00
SiO <sub>2</sub> BEMAS/CRISP	1.2	5.0	3	5 minutes longer (42 total)	1.46	0.00