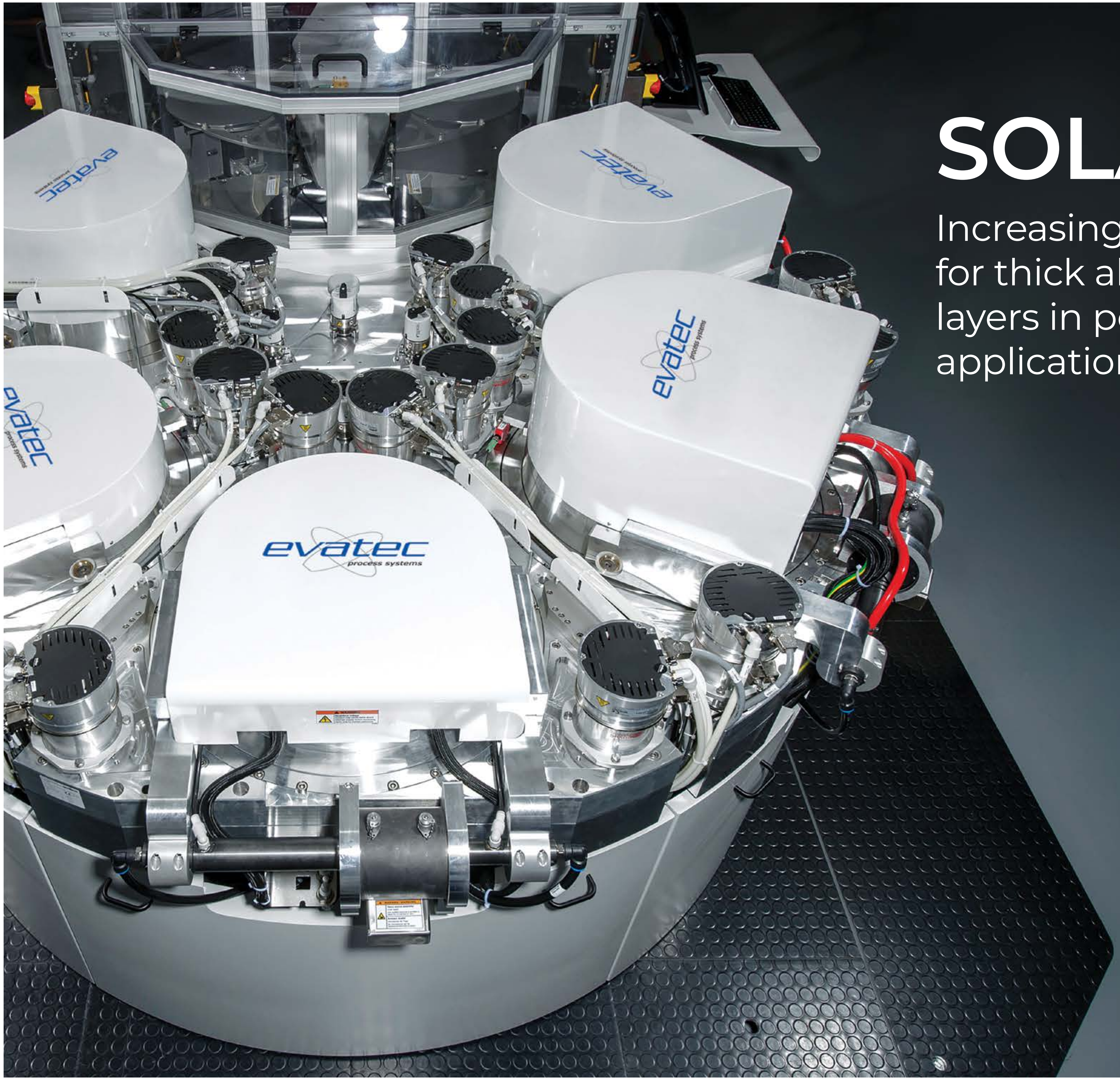
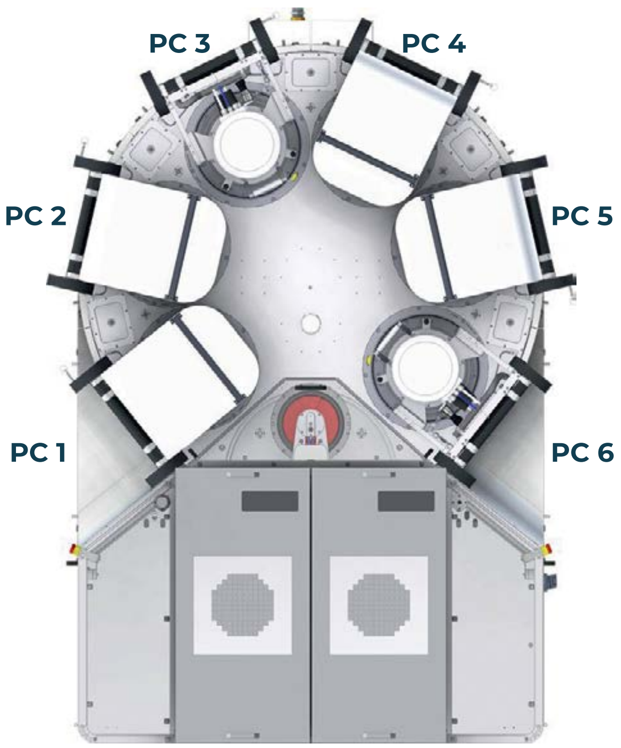


SOLARIS®

Increasing throughput for thick aluminum layers in power device applications

Evatec's Manager Process Development, **Gerald Feistritzer**, shows us how SOLARIS® is proving itself as a valuable addition to Evatec's armoury of thin film production tools in power device applications.

Evatec has a long history of delivering metallization production solutions using both evaporation and sputter process technologies. For many customers and process steps including "lift-off", evaporation remains the technology of choice. For others where fab integration requirements call for elimination of manual wafer handling, cassette-to-cassette processing offers the potential to improve throughput if handling times relative to classical cluster tools can be driven down. In addition, wafer breakage through operator errors can also be reduced, increasing overall process yield. In this article we report on studies to investigate how the SOLARIS® could deliver the thick Al layer performance required with a boost to process throughput.



PC 1, 2, 4 & 5 ARQ 151 Target: Al
PC 3 & 6 Cooling Station CS21 Cooler: Julabo FP51

Figure 1: SOLARIS® S151 configuration for thick Al (4x ARQ151 for Al & 2x cooling station)

Simulations

We knew that the unique handling approach of parallel carrier transfer around SOLARIS® S151 by synchronous indexer was the perfect basis to achieve high speed processing of 8 inch substrates. We would need to meet customers process requirements of sputtering thick Al films (typicaly 1 – 18 µm) on both front and backside of their devices without exceeding typical temperature limits of around 300°C.

Temperature simulations were performed as a first step to define the optimum hardware configuration showing that a SOLARIS® with 4 PVD and 2 cooling chambers would be the best choice.

The process would then consist of Al sputtering in two consecutive chambers until the temperature limit was reached, followed by a cooling step where the substrate temperature would fall back towards room temperature.

With the proposed configuration, we established that two such process sequences could be incorporated in one complete rotation of the indexer. Figures 2 and 3 show two examples, where either 1000nm or 1250nm can be deposited in such a cycle. The process power for this simulation is 13kW.

The design of the SOLARIS® allows for thicker layers to be coated simply by making multiple cycles. This calculation also assumes that seven substrates are always in the tool at the same time (six PVD chambers and one load-lock). We derived a theoretical throughput of almost 60 wafers/hour for 2µm thick Al layers and more than 16 wafers/hour for layers of 18µm (Figures 4 & 5).

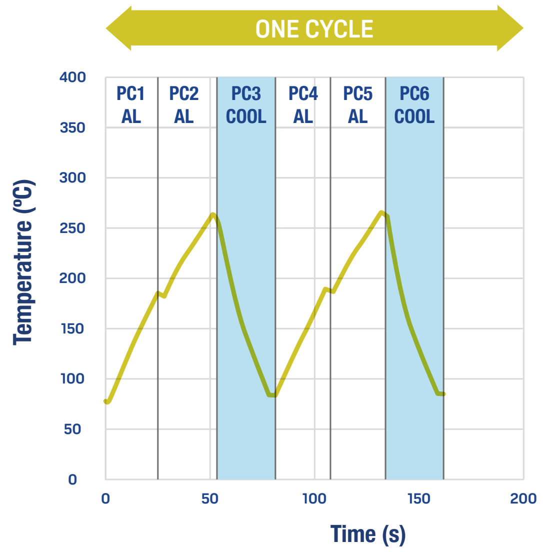


Figure 2: Simulation of substrate temperature for one cycle with 2xAl 500nm / 1x cooling / 2xAl 500nm/1x cooling.

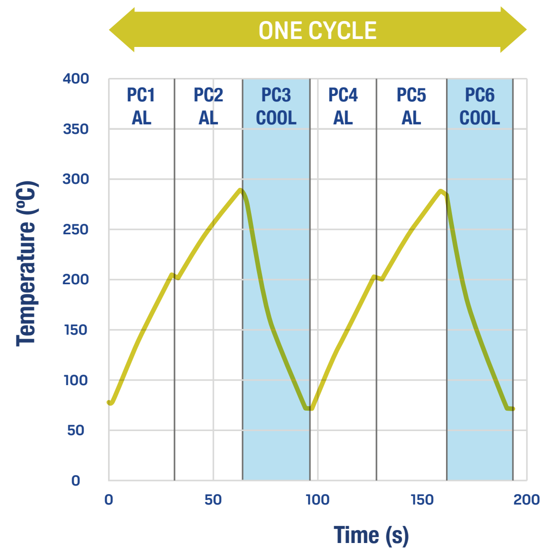


Figure 3: Simulation of substrate temperature for one cycle with 2xAl 625nm / 1x cooling / 2xAl 625nm/1x cooling.

Experimental results

Figure 6 illustrating the uniformity measurement of the sheet resistance of an 18µm thick Al layer on a 6" Si substrate shows acceptable results. In Figure 7 we also then see a comparison of the theoretical throughput values between BAK and SOLARIS® with two different domes showing the gains using SOLARIS®.

The benefits are clear

From these studies we see that SOLARIS® could deliver a significant throughput advantage relative to a BAK when transitioning from 6-inch to 8-inch wafers. With its fully automated cassette-to-cassette solution, and flexible carrier concept changing between substrate sizes is easy. The tool enables clean, reliable, and scalable production of double-sided processes with integrated flipper and a reduced layout, perfectly suited for modern manufacturing demands.

	PC1	PC2	PC3	PC4	PC5	PC6
Process	DC	DC	Cooler	DC	DC	Cooler
Material	Al	Al	n/a	Al	Al	n/a
Sputter rate [nm/s]	21.45	21.45	n/a	21.45	21.45	n/a
Thickness [nm]	625	625	0	625	625	0
Process time [si	29.14	29.14	29.00	29.14	29.14	29.00
Uptime [%]	100					
Cycles	2.00					
Cycle time [s]	30.54					
Throughput Wafer/hour	58.94					

Figure 4: Throughput calculation for 2.0um Al with 13kW sputter power.

	PC1	PC2	PC3	PC4	PC5	PC6
Process	DC	DC	Cooler	DC	DC	Cooler
Material	Al	Al	n/a	Al	Al	n/a
Sputter rate [nm/s]	21.45	21.45	n/a	21.45	21.45	n/a
Thickness [nm]	500	500	0	500	500	0
Process time [si	23.31	23.31	23.00	23.31	23.31	23.00
Uptime [%]	100					
Cycles	9.00					
Cycle time [s]	24.71					
Throughput Wafer/hour	16.19					

Figure 5: Throughput calculation for 18.0um Al with 13kW sputter power.

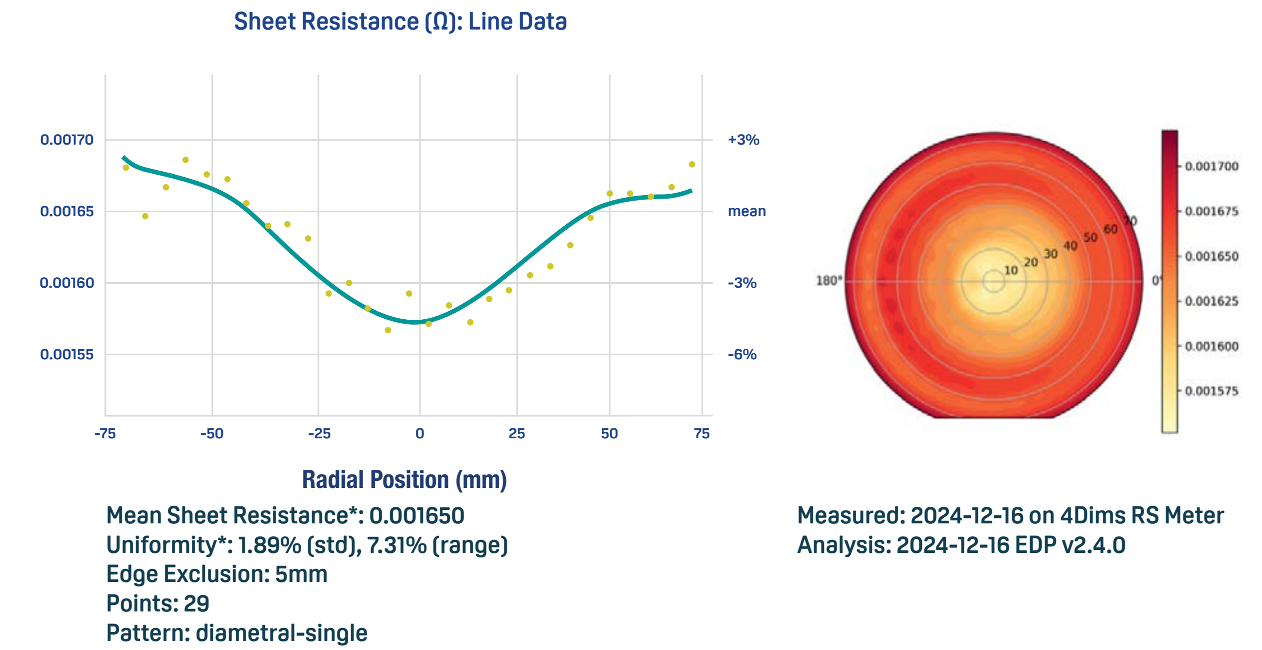


Figure 6: Sheet resistance measurement of 18µm Al layer on 6" Si substrate

Thickness (µm)	Wafer size	BAK 761 (Knudsen)	BAK 1401 Split Chamber (Dome calotte)	SOLARIS®
			Throughput (wph)	
2.0	6"	30.3	34.4	58.9
	8"	12.6	19.6	58.9
18.0	6"	11.8	7.1	16.2
	8"	4.9	4.1	16.2

Figure 7: Comparison of theoretical throughput values (wafers per hour) between BAK and SOLARIS® for 2.0 and 18µm Al coatings.