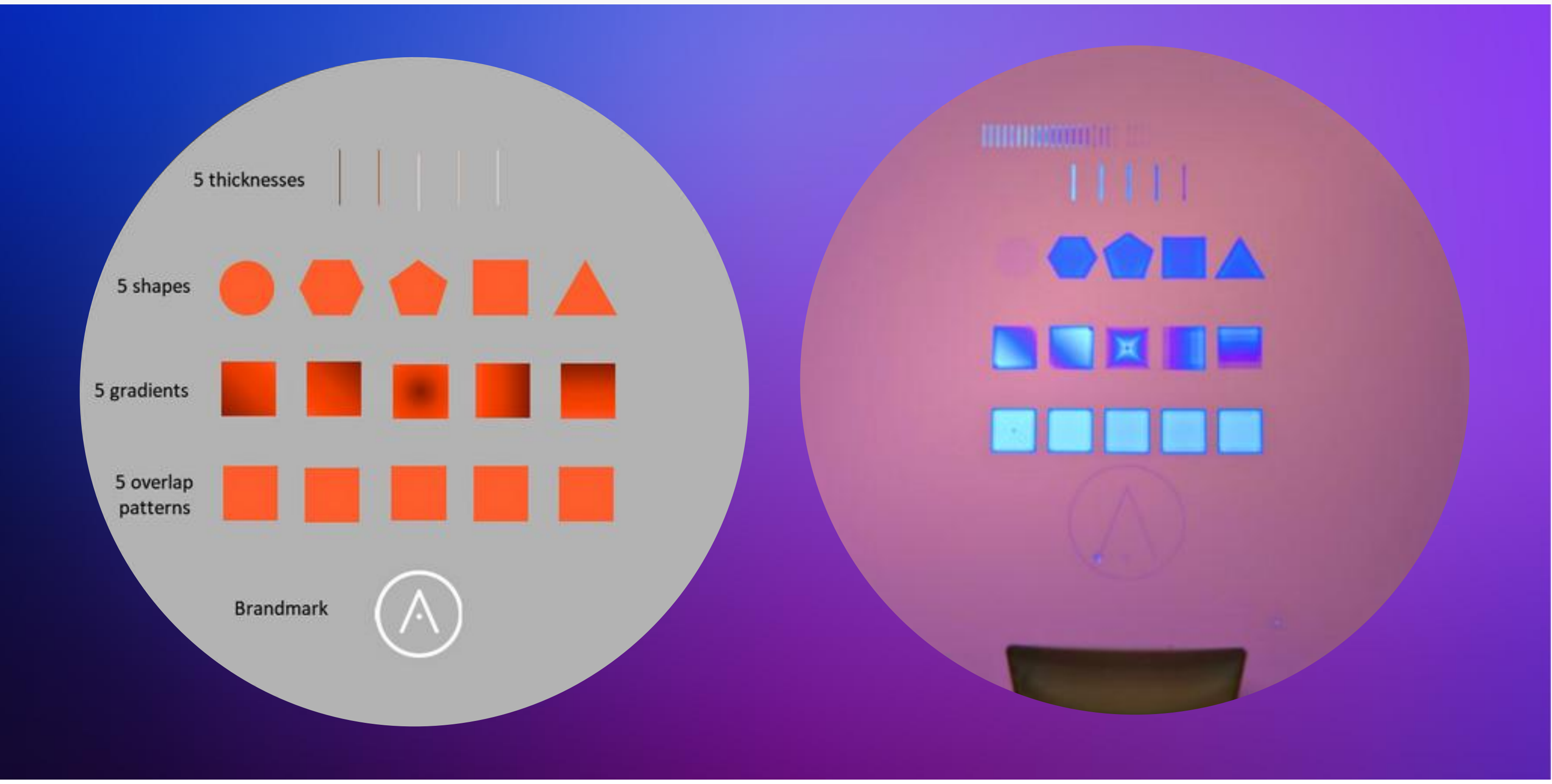
ATLANT 3D

DALP®

Change the rules for semiconductor device designers

DRIVING ADVANCED TECHNOLOGY INNOVATION.
ATOM BY ATOM.

DALP®: Change the rules for microtechnology device designers



ATLANT 3D's Direct Atomic Layer Processing (DALP®) is set to transform the semiconductor landscape with its groundbreaking technology. This cutting-edge process enables swift transition from conceptualization to prototype, reducing the time from idea to physical realization to mere hours. It simplifies exploring new materials and structures for semiconductor devices to just a week, opening doors to multi-functional devices previously deemed unattainable.

With DALP®, you gain access to a wide range of designs, including various 2D shapes, multidirectional thickness gradients, and complex overlapping patterns. The flexibility extends to the materials, DALP opens the ability to utilize standard ALD materials and create tailored multilayers to prototype novel semiconductor devices.

To showcase DALP® capability, we've fabricated a sample wafer using TiO_2 on a 4-inch Si/SiO_2 substrate, with a maximum deposited thickness of 30 nm. The vibrant and distinct color variations stem different thicknesses of the TiO_2 layer and showcase thickness steps of 0.3 nm separated by 1 micron. Traditional methods in the industry require extensive time and effort for such variations, often involving multiple masks or complicated process. Novel processing methods such as inkjet lack the vertical resolution to provide filled patterns with this level of control.

DALP® streamlines this process. From the initial design concept to the start of processing, it takes just 2 hours. The process requires no manual intervention after the setup procedure. Furthermore, DALP® drastically reduces chemical usage, relying on a few micrograms of precursors instead of the substantial quantities of target material, resists, and chemicals used in conventional methods.

KEY FIGURES FOR DALP® PROCESSING

- Ideation and CAD design of all shapes: approximately 1 hour
- Conversion of CAD designs to machine code, including input of thickness and material parameters: approximately 30 minutes
- TiO_2 structure processing: 17 hours (overnight)

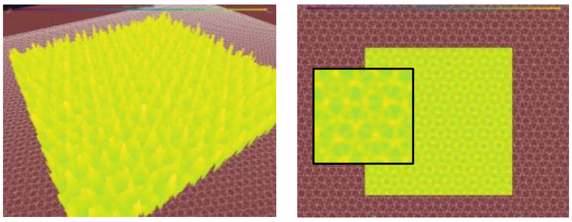
Tasks	ATLANT 3D			Conventional Semiconductor Manufacturing (30 Lithography steps)		
	Machine time	Man Hours	Number of Steps	Machine time	Man Hours	Number of steps
Processing of all shapes with TiO2 (30 thicknesses)	17 h	0.5 h	1	60h	50 h	180

DALP® significantly reduces process steps and time, enhancing prototyping speed and enabling the creation of devices with functionalities previously deemed impossible.

The diverse shapes designed through DALP® offer substantial benefits to several applications, including:

- **Optics:** optical coatings, Bragg mirrors
- **Electronics:** vertical thin film capacitors, thin film integrated circuits
- **Neuromorphic computing:** variable thickness hybrid neural networks
- **MEMS:** functionalized surfaces, encapsulated devices
- **Sensors:** electrochemical, gas, distance, temperature, pressure, humidity
- **IC postprocessing:** chip surgery, IC repair
- **Smart coatings:** engineered surface properties

Software simulation of a TiO_2 DALP® deposition

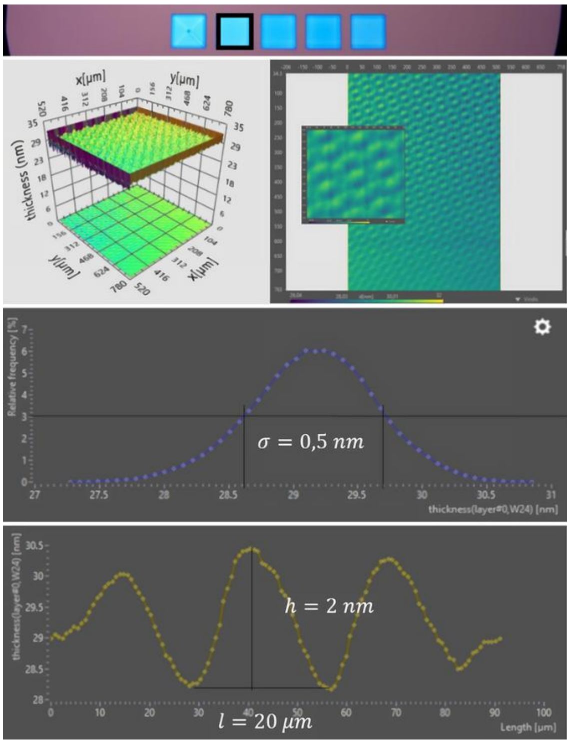


RASTERED PATTERN SIMULATION, DEPOSITION, CHARACTERIZATION

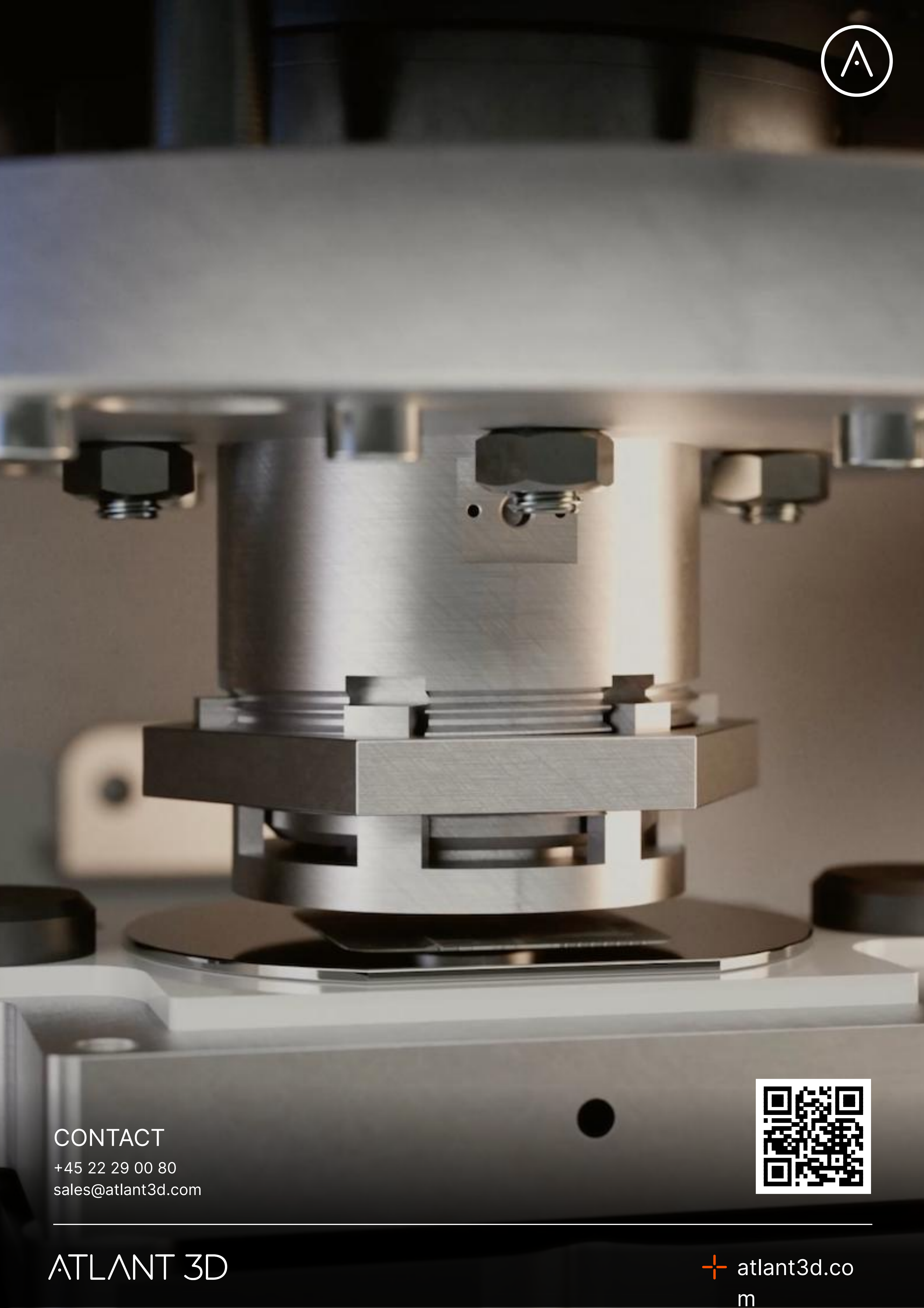
The different rastering methods of the set of squares were simulated in our software, deposited using DALP®, and finally characterized with imaging ellipsometry.

DALP® produced a repeating 2 nm-tall hexagonal pattern with a 20 µm period over an area of 4×4 mm^2. It is also possible to deposit, e.g., a square pattern 6 nm height oscillation and a 100 µm period.

These patterns are attractive to applications that require surface nanopatterning, e.g. changing surface wettability or optical characteristics.



Imaging ellipsometry measurements of TiO_2 DALP®



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