Multi-Material Deposition for Spatial Atomic Layer Deposition Process

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Spatial Atomic Layer Deposition (sALD) offers a unique opportunity for localized deposition due to its physical separation and isolation of precursor and co-reagent dosing.[1] While simple in theory, due to well-developed examples of sALD, in practice miniaturization of sALD requires substantial effort into the creation of suitable micro-nozzles.[1] Uniquely, ATLANT 3D has developed proprietary sALD micronozzles, called microreactor Direct Atomic Layer Processing - µDALP™.

The µDALP™ process undergoes the same cyclic ALD process but is only done in a spatially localized area.[2] The microreactor or micronozzle confines the flows of gases used for ALD within a defined µm-scale area on the substrate, to deposit the desired material.

Since sALD and the µDALP™ process are based on physical separation, it is theoretically compatible with any ALD material process however requires development as ALD processes are highly tool dependent.[3] As such, the material capabilities can match traditional ALD and exceed other patterning techniques, such as lithography, which can be costly and time-consuming, especially for rapid prototyping required for innovation.[4,5]

Using a small amount of precursor multiple film materials and thicknesses can be deposited onto a single wafer within only a few hours, compared to days for a traditional ALD process (Fig 1.). Films deposited with ATLANT 3D technology have been shown to produce high-quality, crystalline, atomically precise thin films used to fabricate temperature (Fig 2.) and capacitive sensors with sensitivities that meet or exceed those of devices made using conventional vapor phase deposition techniques . Low-cost rapid prototyping facilitated by ATLANT 3D technology of such devices enables design innovation and optimization not possible with other thin film deposition techniques.

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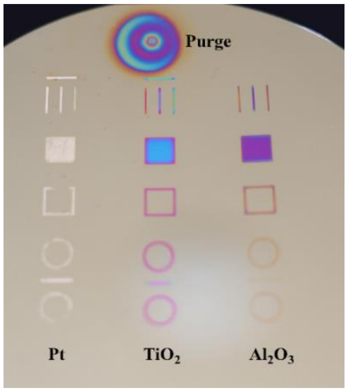

Fig 1. Photograph of 200 mm SiO2 silicon wafer substrate with thin films deposited using µDALP™.

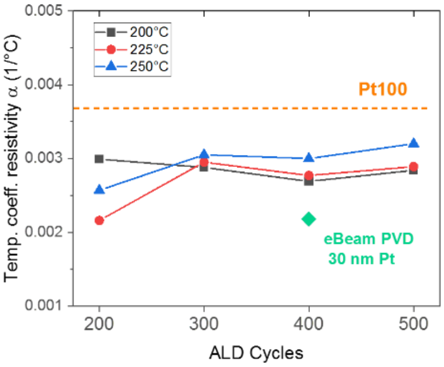

Fig 2. Temperature coefficient of resistivity of µDALP™ devices fabricated at different temperatures. Performance approaches that of a standard macroscopic Pt100 sensor and is superior to a lithography-processed reference.[2]