



# The Spin Coating of Patterned Sapphire Substrates

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## The Spin Coating of Patterned Sapphire Substrates

One of the critical steps in the manufacture of Patterned Sapphire Substrates (PSS) is the photolithographic process which creates the desired “bump” pattern on the surface of the substrate. The process typically involves the following process steps:

### 1. Photoresist spin coat

#### a. Wafer Handling steps

- i. The substrate is automatically withdrawn from a cassette.
- ii. The substrate is precisely positioned on a rotatable vacuum chuck such that the center of the substrate is coincident with the center of rotation of the vacuum chuck.
- iii. After photoresist is applied the substrate is baked (normally on a heated plate provided for the purpose.)
- iv. The substrate is returned to the cassette or to a second cassette.

#### b. Photoresist coating steps

- i. The substrate is rotated at a speed of approximately 500 rpm and a pre-wet dispense using the same solvent used in the photoresist, normally NMP or PGMEA is briefly dispensed and “spun” off at a speed of about 1500 rpm. The purpose of this step is to remove any dust particles from the wafer surface that could affect the quality of the deposited film and to effectively pre-wet the surface of the sapphire with a monolayer of solvent molecules so that the surface can more readily accept the photoresist. This also has the effect of reducing the quantity of photoresist that needs to be applied thereby reducing chemical costs. The small quantity of solvent used is more than compensated by the reduced quantity of photoresist required.
- ii. The rotational velocity of the substrate is maintained at about 1500 rpm and the photoresist is dispensed at the center of the wafer for about 1 second. It is important that this be done immediately after the last Newton ring of solvent has evaporated.
- iii. The rotational velocity of the substrate is increased to the speed at which the desired photoresist thickness is obtained. This speed will be highly dependent upon the resist viscosity. The acceleration to achieve the desired velocity will be on the order of 4,000 to 8,000 rpm per second. Precise control of both the acceleration and the velocity will determine the uniformity of the film thickness within a given substrate, from substrate to substrate and lot to lot.

### c. Other critical aspects of producing defect free uniform spin cast films

- i. Exhaust of the spin cup 360 degrees
- ii. Material selection of the dispense valves, tubes, etc.
- iii. Adequate provision for elimination of any “final drop”.
- iv. A means of back side rinse without creating wet spots on the wafer back side.
- v. A means of properly centering the wafer with respect to the spin chuck.
- vi. Proper material selection, cleaning and draining of the spin cup.
- vii. A means of keeping the dispense tip free of dried resist.

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### About Mr. Gary Hillman

Mr. Gary Hillman has enjoyed a long and distinguished career in the engineering and semiconductor industries. A graduate of the Georgia Institute of Technology with a B.S. in Ceramic Engineering, Mr. Hillman began his career with Corning Glass Works in Corning, New York.

Mr. Hillman has made multiple critical contributions while working at a variety of companies during his long and successful career, including receiving a patent for the semiconductor industry’s first practical “robotic” wafer handling system while working at Machine Technology, Inc. in Parsippany, New Jersey. Since then, Mr. Hillman has 22 patents to his credit.

Mr. Hillman served as the Chairman of SEMI Standards in 1987 and Chairman of SEMI in 1989.

In 1994, Mr. Hillman and a group of others formed Service Support Specialties, Inc. and Creative Design Corporation. Service Support Specialties, also known as S-Cubed, evolved over time into a leading manufacturer of Photoresist processing tools and associated robotics.

Mr. Hillman has helped to develop significant advances in the engineering and semiconductor industries. He and his dedicated team at S-Cubed work to meet and exceed the needs of their customers.

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