

# Development of Alternative to Spin-On Method of Thin Film Deposition Using Liquid Precursors

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**Abstract:** The project is concerned with mist deposition process which is under development as an alternative to spin-on method of thin film deposition using liquid precursors. Mist deposition can be significantly more efficient than spin-on technique in selected applications particularly in the case of films thinner than about 100 nm. The focus of this project is on the deposition of low-k dielectric films and photoresist as these two materials are commonly deposited by spin-on process.

## Project Summary:

Liquid precursors are used in semiconductor processing as source materials in the formation of thin film dielectrics and photoresist. A deposition method in these cases is typically a spin-on process in which well controlled amount of liquid is dispensed onto the substrate surface and distributed over it by centrifugal forces created by wafer rotation at thousands of revolutions per minute. Following deposition the wafer is subjected to low temperature anneal to drive solvents out and to solidify a film.

The spin-on process is relatively simple to implement, works well in the variety of applications and as such is commonly used in semiconductor processing. However, it features some inherent shortcomings. Most importantly, the spin-on process is wasteful as only small part, typically less than 5%, of the liquid dispensed on the surface stays there in the form of a thin film while the remaining material is spun-off the rotated substrate and wasted.

An alternative to spin-on technique of covering solid surfaces with liquid precursor is a method of “mist deposition”. As name indicates, the liquid in this case is slowly delivered to the substrate in the form of a very fine mist which then uniformly coalesces on its surface. Mist deposition is followed by thermal curing of the film.

In this study commercial mist deposition system (Primaxx, Inc., Allentown, PA) integrated with low-temperature RTP module is used. Materials tested are low-k interlayer dielectrics (SiLK, Dow Chemicals) and photoresist, i.e. those materials which are most often deposited using a spin-on process. Initial experiments produced promising results in both these applications. Figure 1 compares I-V characteristics of mist and spin-on deposited SiLK of comparable thickness. Higher leakage current was observed in the former case, but

essentially no difference in the value of breakdown field was noted. Even more promising preliminary results were obtained in the case of mist deposited photoresist. Figure 2 shows photograph of the pattern delineated in mist deposited photoresist. This effort will continue toward full evaluation of the feasibility mist deposition in photoresist processing.

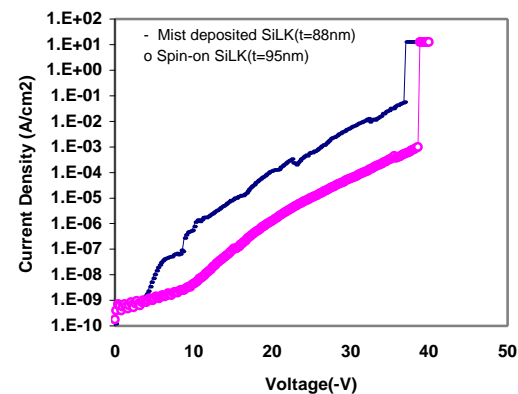


Fig. 1: Current-voltage characteristics of spin-on and mist deposited SiLK.

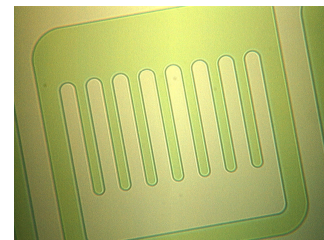


Fig. 2: Pattern defined in mist deposited photoresist film.

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