
TECHNICAL NOTE H-18-93

INHIBITED DRYING SPIN COATING

Headway Research, Inc. first proposed and proved the benefits of **Inhibited Drying Spinning** in 1985 to improve the uniformity of coatings applied by spinning, on rectangular (such as LCD) or large circular substrates (such as video laser disc masters). With this technique, uniform coatings can be achieved to all edges of a square or rectangular plate.

By saturating the atmosphere at the surface of the substrate with a solvent vapor such as the "thinner" compatible with the coating material, and thus preventing any drying during the spin distribution of the fluid, many advantages can be achieved. Acceleration variation is no longer a significant variable, air exhaust volume and flow pattern is no longer a variable, humidity variations are "swamped out" and are of far less significance. Edge bead on non-polled edges is greatly reduced by surface tension leveling, when the spinning stops. Significant automatic leveling over topology of prior processes is automatically achieved. Droplets of the coating material sometimes thrown from the "white caps" of the turbulent wave fronts traversing the accelerating substrate are no longer a problem. Since the drying is inhibited, more viscous materials with high vapor pressure solvent can be successfully applied as thinner coatings. The process is much more repeatable since the complexity of the process is reduced to primarily spin speed and time. Larger substrates can be coated at lower rpm's by merely increasing the spin time.

The negative feature of IDS is the requirement to tie up the spinner if the substrate is allowed to air dry stationary (or at slow rotation) on the machine, or the requirement of handling the wet substrate and protecting the substrate in a clean area while drying, if the spinner is to be freed quickly for more throughput.

Also, in the past, the drying has been inhibited by placing a cover over the substrate, turning off the air exhaust on the machine and allowing the atmosphere at the substrate surface to saturate with solvent.

This causes new difficulties with dispensing the fluid, handling the closure, and the potential of particles falling from the cover or handling process and, increased difficulty in dealing with automating the loading and unloading of the substrates.

With a large 22" diameter spinner, Headway has developed a way to eliminate the closure of the bowl above the substrate and can automate all aspects of the procedure to overcome the above problems. We can do this by;

- A. Automatically shutting off the air exhaust line to the bowl.
- B. Injecting saturated gas into the bottom of the bowl.
- C. Withdrawing the excess saturated gas with a vacuum collector system at the top of the bowl during the inhibited drying portion of the process.
- D. Automatically returning to an exhausted bowl condition at the end of the spin coating cycle to protect the lab and personnel as required, and to allow the substrate to dry stationary.

The potential benefits of Inhibited Drying Spin coating with photo-resists, polyimides, etc. can generally be experimentally evaluated with existing spin coating equipment. If the exhaust is temporarily turned off, a glass plate, petri dish, watch glass or such is used to cover the spinner bowl to close the environment, then the residue from the bowl walls and fluid pool on the substrate will usually provide sufficient vapor to inhibit the drying of the film while spinning. It is then necessary to experiment to find the correct combination of spin speed and spin time to obtain the final film thickness desired. Also experimentation is required to find the minimum air drying time (stationary) to permit bake-out and further processing of the coated substrate.

Once the Inhibited Drying Spin coating (IDS) principle has proven beneficial to obtaining desired results, Headway has several ways to help make the technique practical. Contact Headway for assistance.

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