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Coloursmith

Spin Coater for Thin Film Application

Coloursmith Labs

- Coloursmith Labs Inc. is a nanotechnology company that designs optical light filters to improve lenses and vision. Optical filters are created through thin-film application and treated by the company.

Project Scope

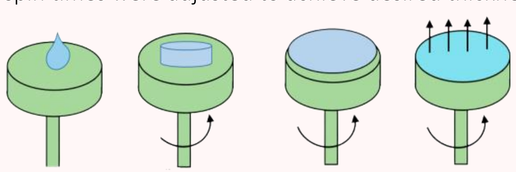
- Thin film applicators are very expensive, and Coloursmith uses solvents that have highly corrosive chemicals.
- The purpose of this project was to build an economical, repeatable, thin-film applicator to apply a thin film onto glass slides. The material used in the design must be compatible with Coloursmith solvents. In addition, the equipment must be easily integrated into Coloursmith's existing R&D process.
- Common issues Coloursmith experiences with their existing application method are inconsistent layers of thin-film, long coating times, and large solvent waste.

Requirements

- ✓ Apply 20-50-micron layer of thin film to slides.
- ✓ Repeatable with tolerance of 2 microns.
- ✓ Use a maximum of 2 mL of solvent per slide.
- ✓ Cost less than $1 000 CAD to build.
- ✓ Require less than 5 minutes per slide to coat.
- ✓ Coat only one side of the glass slide.
- ✓ Usable for range of solvent viscosities 0.024 - 1.3 kg/m*min.

Spin Coater

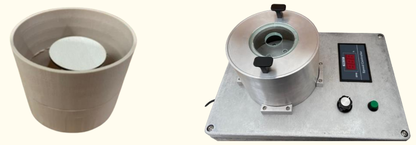
- Spin coaters were the optimal technique to apply thin film with minimal manual interference, and high repeatability.
- Spin coaters apply thin film through centripetal force. The thickness of the thin film is adjustable by varying the viscosity, spin time and/or altering motor speed.
- This application had fixed viscosities; therefore, motor speeds and spin times were adjusted to achieve desired thickness.



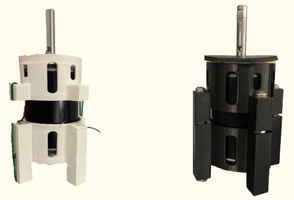
(Ali et. al., 2019)

Design Process

- Two enclosures, and three motor mount prototypes were created.
- Enclosure part sizes were minimized to reduce weight and material, and openings to insert parts were enlarged for ease of use.
- Accessible point of entries were put into second enclosure build for operator to adjust slides with more ease.
- Damping material was added on top of the motor mount to minimize vibration and excessive sound.
- Motor mount material was changed to PET-G for better heat resistance, and longer supports were added to improve the rigidity of the part.

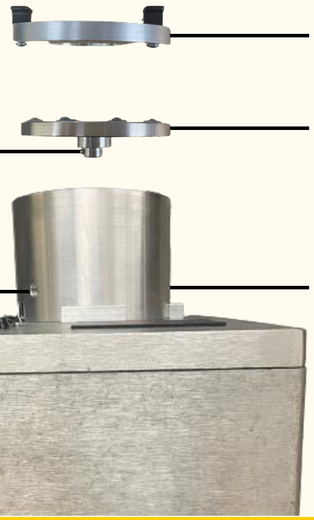


Prototype Final



Prototype Final

Mechanical Design



Lid
Aluminum, handles for easy use, glass top to see experiment when running

Glass Tray Holder
Aluminum, custom chuck to attach to motor shaft. Glass slide sits on top with 6 screws to hold it down

Set Screw
Secures glass tray holder to motor shaft

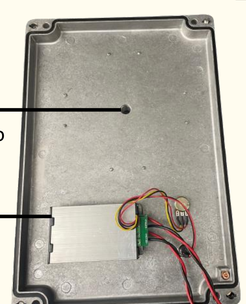
Allen Key Entrance
Allows access to tray holder set screw

RPM Dial
Knob alters motor RPM

Chemical Enclosure
Aluminum, internal ridge to hold chemical excess spun off glass slides

Electrical Enclosure
Explained in section below

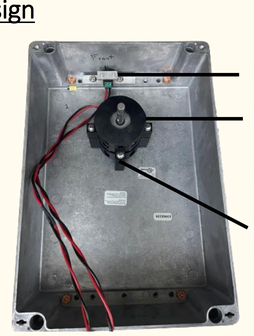
Electrical Design



Motor Shaft Hole
Motor Shaft attaches to glass tray holder

RPM Display
Displays motor speed

Top Panel



Power Cables

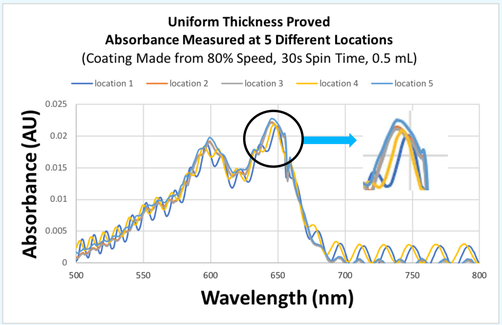
Rubber Washer
Damper between top panel and motor for vibration

Motor Mount
7000 RPM Motor

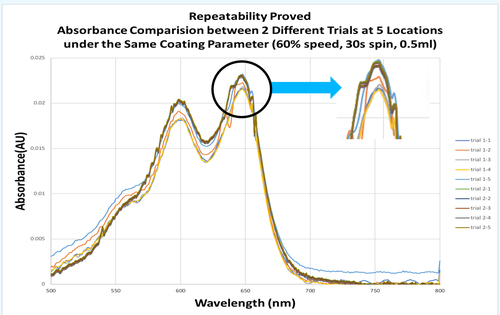
Electrical Box

Results

- If thin-film thickness is unform, the peak absorbances of each position should be equivalent.
- Consistent layers of thin-film measured at 5 different locations with peak absorbances around 0.022 (AU).



- Repeatable thin-film created for different trials with close average peak absorbance of 0.023 AU with same coating parameter.



Conclusion

- Spin coater creates uniform, repeatable thin film thickness

Recommendations

- Increase the size of the glass tray holder to spin more than one glass slide per run.
- In the future, calculation can be performed to find the exact thickness of the coating:
- A(absorbance)= Ɛ(extinction coefficient)*L (path length(thickness))*c (concentration)

References

Ali, H., Al-Sharafi, A., & Yilbas, B. S. (2019). *Self-cleaning of surfaces and water droplet mobility.* Chalcogenide Glasses.