

Investigating Spray-on Techniques for Silica Microsphere Based Coating for Radiative Cooling

Jacob Cytrynbaum¹, Sarun Atiganyanun², Sang E. Han², and Sang M. Han²

¹Williams College, Williamstown MA ²University of New Mexico, Albuquerque NM

Problem: High energy and monetary costs of cooling. Radiative coatings are a possible solution, but they must be optimized

Goal: Optimize spray coating method of fabrication for silica microsphere based for radiative coatings by varying parameters to reduce the transport mean free path (l^*), thus maximizing cooling properties of the coating.

Process and Methods:

Preparation

- Spray coat glass slide with an aqueous suspension of 1 or 2 μ m spheres
- Add detergent to reduce surface tension of the solution
- Vary thickness at one condition

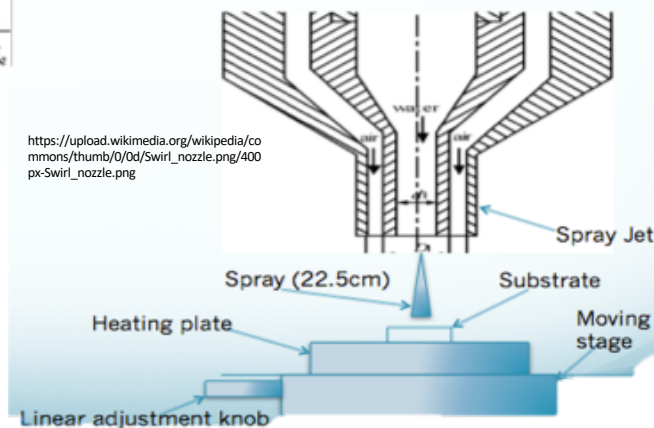
Analysis

- Measure Transmittance (T) with an integrating sphere
- Measure Thickness (L) with SEM imaging
- Extract transport mean free path (l^*) from a linear regression of $1/T$ vs L

$$\frac{1}{T} = \left(\frac{1}{T'}(1+z_e) \right) L + \frac{2z_e}{1+z_e}$$

Where z_e is a constant

https://upload.wikimedia.org/wikipedia/commons/thumb/0/0d/Swirl_nozzle.png/400px-Swirl_nozzle.png

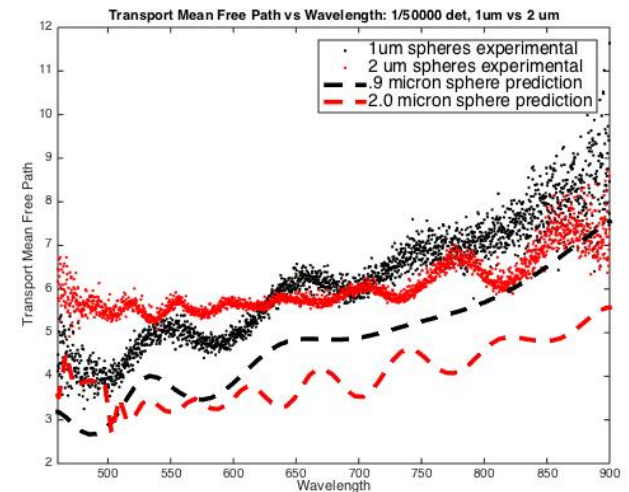
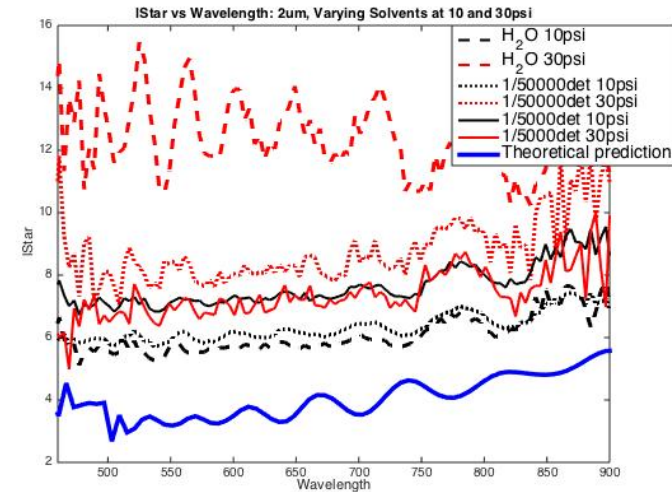


Results:

For 2 μ m spheres, low pressure spraying (10psi vs 30psi) to produce lower l^* values

At 10psi, pure H₂O as a solvent produces lower l^* values than H₂O with varying concentrations of detergent

Both 1 and 2 μ m spectra are not as low as the predicted spectra



Future Work:

- Investigate l^* as a function of filling fraction
- Measure cooling properties under direct sunlight