



Investigation of the effects of potassium chloride concentration on the transport mean free path of colloid-deposited silica microsphere-based coatings

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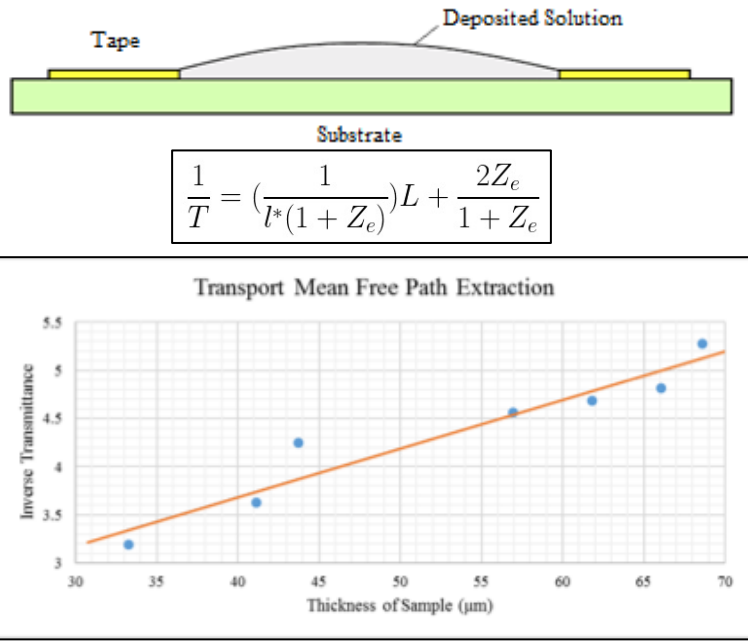
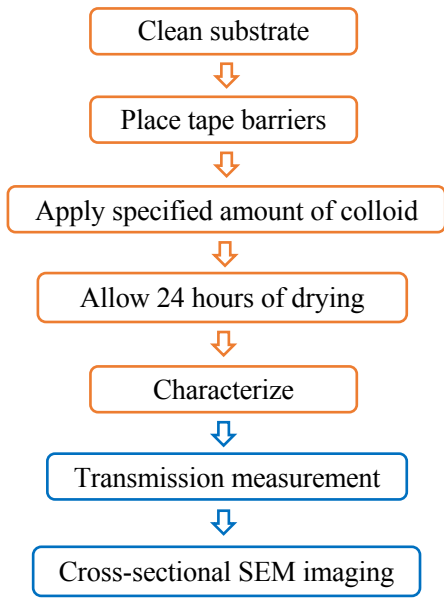
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Problem: With electricity expenditure in record-breaking numbers and climbing, one possible alternative being explored is radiative cooling.

Goal: Photonic glass, which is composed of silica microspheres in a random packing order, is capable of providing radiative cooling. We seek to optimize the transport mean free path (denoted l^*) of these assemblies by use of potassium chloride solutions of varied concentrations.

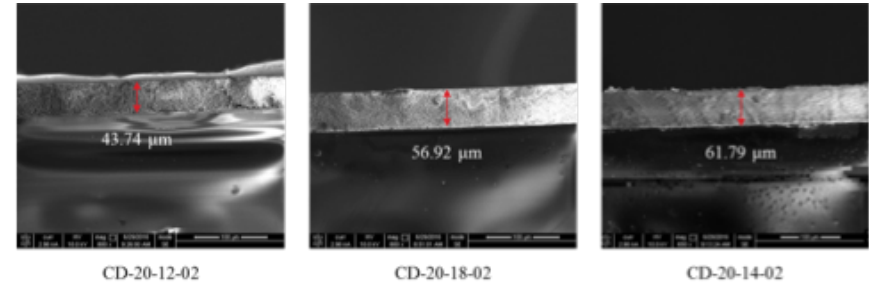
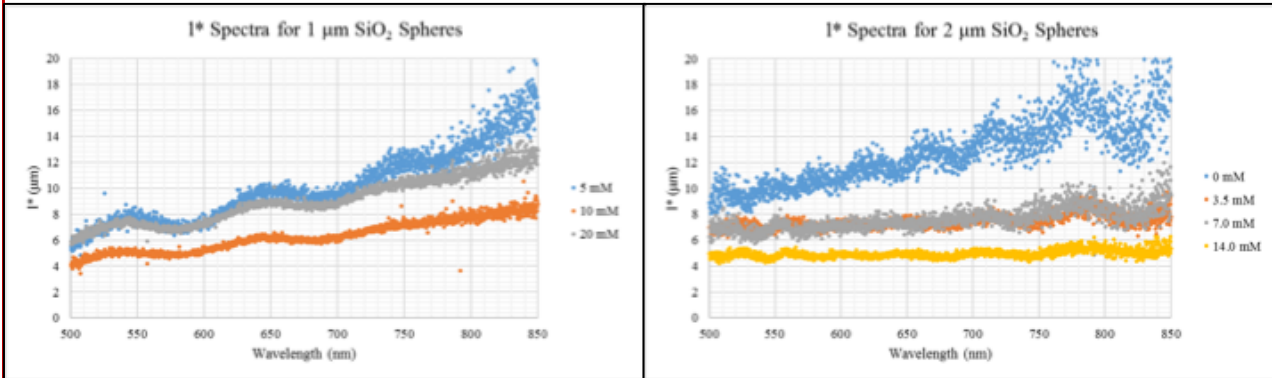
Method:



- Varying thicknesses (denoted L) are achieved through varying volumes of deposited solution. We use salt to decrease the Debye length of the spheres, facilitating their coagulation in solution, inducing random packing.
- l^* is extracted through the linear regression of the inverse transmittance (denoted T^{-1}) as a function of sample thickness plot at each wavelength (above). A lower l^* spectrum means a stronger light scattering ability, which is favorable. Z_e in the above equation is the extrapolation factor, a constant.

Results:

- With respect to 1 μm spheres, experimental data has demonstrated that the ideal concentration for the lowest possible transport mean free path spectrum is 10 mM in potassium chloride.
- With respect to 2 μm spheres, the ideal concentration is of 14 mM in potassium chloride.
- Higher concentrations of potassium chloride cannot be explored due to the crystallization of the salt on the substrate, creating voids in the coating.



Next Steps:

- To construct samples tuned to the desired transport mean free path length.
- Test the aforementioned samples to obtain their experimental cooling properties.