CAPILLARY SELF ASSEMBLY OF 3D NANOSTRUCTURES

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The objective of this project is to design and manufacture a chamber for controlling the capillary forces that cause self-assembly of nanostructures on a substrate. Means of delivering controlled volumes of liquids to a substrate surface have been designed, along with the controllability of evaporation using humidity measurements along with temperature, and pressure control. Our machine is intended for research, and therefore is highly reconfigurable. The machine is able to place particles in suspension onto a substrate in small volumes dispensed by a capillary tip.

Initial bench top experimentation was used to form relevant engineering specification critical to the process. We identified surface hydro-phobicity, electric field, and substrate and depositor motion as key factors to achieving ordered self assembly. The ability to selectively deposit islands of assembled nanoparticles in proximity is sought. Major design challenges indentified early on included: long lead time for ordered parts, uncertainty in scalability, resolution and control at such a small scale, and unavoidable cost tradeoffs.

Our machine is capable of dispensing discrete and continuous amounts of particles-in-suspension onto a substrate through an interchangeable capillary tube. The substrate translates in X, Y, and Z directions. The deposition system is enclosed in an environmental chamber capable of controlling pressure, humidity, and temperature.

This project is sponsored by Professor John Hart of the University of Michigan Mechanical Engineering department in conjunction with his graduate student, Mostafa Bedewy. The design process has been overseen by both Professor Hart and Professor Awtar throughout the semester.