

Templated Assembly by Selective Removal

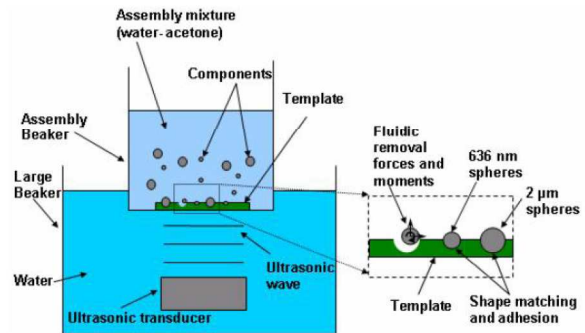
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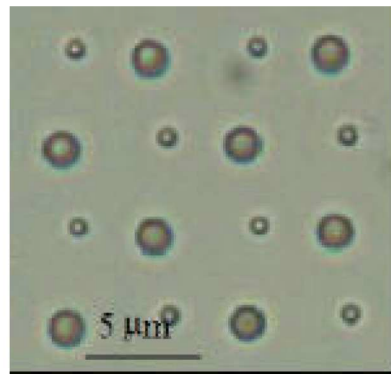
Templated assembly by selective removal (TASR) is an effective technique for site-selective multi-component assembly at the nano- and micro-scales. In this project, the TASR approach has been created, demonstrated and quantitatively modeled; work to expand the technology and exhibit practical applications is now underway. The TASR approach offers great promise for assembling arbitrary (not necessarily periodic) systems of multiple different types of nanoscale components, such as electronics and biological or chemical sensing devices. It also offers a path to a new kind of shape- and size-selective chromatography.

TASR employs a combination of chemistry, surface topography and controllable ultrasonically-induced fluid forces to assemble diverse sets of objects selectively from fluid into designated sites on a 2D surface [1]. Figure 1 shows a schematic layout of the process set-up. The components and the substrate, after undergoing chemical surface modification by a coating of an adhesion promoter, are placed in a fluid environment for the assembly process and megahertz frequency ultrasound is applied to the fluidic bath. Competition between the chemical adhesive effects and fluidic removal forces takes place in which adhesive forces emerge as stronger for components in a well-matched site. The selectivity is based on the degree to which the component to be assembled matches the shape and dimensions of the surface topography at that location. Figure 2 is an optical micrograph showing the successful assembly of 600 nm and 2 mm diameter silica microspheres using TASR. Experiments are now being conducted to extend the technique to a variety of different materials such as biological cells, polymers and nanorods which vary markedly not only in their physical configuration and properties but also in their chemical interaction with the substrate onto which they are to be assembled.

Thus, TASR can be used as a low-cost nanofabrication method with the ability to create complex, arbitrary patterns. We are also investigating the extension of TASR to a shape- and size-sensitive separation mechanism enabling the fabrication of a filtering device with chromatography applications. Present work focuses on the extension of TASR to smaller size scales, a diverse set of component shapes and materials, and improved template fabrication techniques with the goal of demonstrating numerous practical applications enabled by this approach.



▲ Figure 1: Concept schematic of Templated Assembly by Selective Removal (TASR).



▲ Figure 2: Silicon microspheres self assembled on a templated silicon-silicon dioxide substrate.

References

- [1] S. Jung and C. Livermore, "Achieving selective assembly with template topography and ultrasonically induced fluid forces," *Nanoletters*, vol. 5, no. 11, pp. 2188-2194, Nov. 2005.