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הפקולטה להנדסה כימית
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Capillary Bridges Between Solids

Capillary bridges are small volumes of a liquid trapped between two or more surfaces. Systems and processes in which liquid bridges appear and are of interest include (but are not limited to) particle aggregation, flocculation of slurries, coating of liquid films on solids, textile wetting and cleaning processes, liquid aerosol filtration, fiber (wire) agglutination, soldering, dispersion of particles in the atmosphere, drying of porous media and condensation within porous media.

Previous studies have been mainly concerned with the adhesive (or cohesive) forces as well as torques obtained between surfaces via capillary bridges, as well as the stability of the bridges with respect to rupturing. A recent study (T-L Cheng and Y. U. Wang, Langmuir **2012,** 28, 2696).focused on interactions among adjacent capillary bridges spontaneously formed between closely packed colloidal particles. Such a mechanism provides desired microstructural stability and uniformity to the capillary bridges that are spontaneously formed in colloidal crystals during liquid solution phase separation. Contrary to intuition, based on the concept of Ostwald ripening, thermodynamic stability can be achieved in this system when the capillary bridges do not coarsen or coalesce; instead, they mutually interact through diffusion to reach a uniform equilibrium shape and size distribution. This is based on a uniform underlying lattice of uniform sized solid spheres.

The focus of this contribution is on the basic understanding of energy minimization in systems involving liquid bridges. To this end the case of nonvolatile and incompressible bridges between a number of surface geometries is first considered, where the impact of system geometry on the type of global energy minimum (i.e. involving single or multiple bridges) is investigated. Following this, systems involving volatile and, in some cases compressible (i.e. gaseous) bridges are considered. These systems have a strong relevance to condensation and drying (or evaporation) phenomena in porous media. Relevant equations are formulated and a few select cases are presented, exhibiting (under certain conditions) capillary bridges which are stable with respect to Ostwald ripening.