Photonic colloidal crystals as nano-sand: lab-on-a-chip to study water in granular media

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Abstract

Solid particles ensembles inherently contain water adsorbed from the ambient moisture. This water, confined in the interstices between the building grains, greatly affects the ensemble properties. Inversely, one can benefit from such influence on collective features to explore the water behavior in such confinements. However, little is known about the behavior of water in small environments, in spite of its relevance in many areas of materials science nowadays. We have developed novel approaches to investigate in-depth where and how water is placed in the nanometric pores of self-assembled colloidal crystals [1]. Above all, their photonic properties are significantly affected by the water, not only by its content but also by its distribution. This fact renders the colloidal crystal a suitable '*lab-on-a-chip'* to study the water morphology within the porous network, and provides a simple but powerful tool to address fundamental aspects of nanoconfined water [2-5]. I summarize these advances, which are linked to general interfacial water phenomena like adsorption, capillary forces and surface flow, and, importantly, to the interplay between nanoconfined water and solid fine particles that determines the behavior of ensembles. I describe how the knowledge gained on water in colloidal crystals provides new opportunities for multidisciplinary study of interfacial and nanoconfined liquids and their essential role in the physics of utmost relevant systems such as particulate media [6]. A latest project searches for original links to granular materials, from powders to soils, for which colloidal crystals are proposed as a novel model system, in particular, through their micromechanical properties [7]: a kind of '*nano-sand*' with promising utilities.

References

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Figures