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Investigation of pore-scale colloid retention in unsaturated porous media

Understanding colloid retention mechanisms is crucial for the ability to predict colloid and colloid-associated transport of contaminants in soil. We consider soil as unsaturated porous media, which is a broadly used representation of soil intended for better understanding of key colloid transport and retention processes.

Current research projects include investigation of pore-scale colloid retention in unsaturated porous media employing micro-scale devices and confocal microscope. Looking at colloid behavior at pore scale can provide important information on colloid retention mechanisms and on parameters affecting it. More specifically, the focus of current work is on colloid retention in the interfacial region including air-water interface (AWI) and contact line.

I. Open channels have been employed to study colloid retention at AWI and contact line in both static and dynamic experiments. The open channel flow system is shown in Figure 1. The channels were imaged with a confocal microscope; the collected images were processed using an advanced imaging software “Volocity 3.0.1” (Improvision) to obtain quantitative information from the images. A typical confocal image of an open channel showing AWI, contact line, and colloids at AWI is shown in Figure 2. In this study, the effects of ionic strength and hydrodynamics

on colloid retention have been investigated. For more information, please, refer to the following publication:
Lazouskaya, V., Y. Jin, and D. Or, Interfacial interactions and colloid retention under steady flows in a capillary channel, *J Colloid Interface Sci.*, 303 (2006) 171-184.

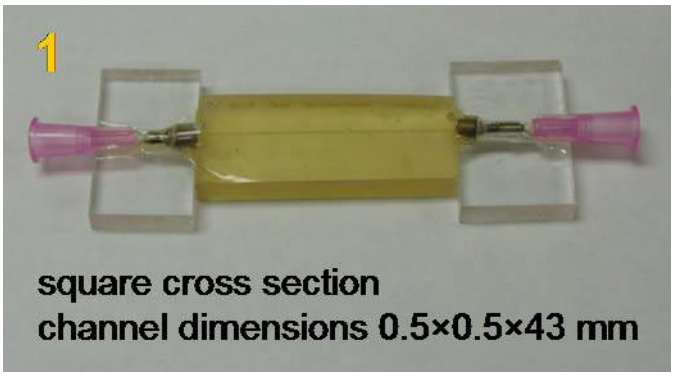

Figure 1. Photograph of an open channel utilized in dynamic (flow) experiments.

Figure 2. Confocal image of AWI and contact line in an open channel.

II. **Microfluidic channels** (Figure 3) have been utilized to study colloid behavior relative to advancing and receding interfaces. The channels have trapezoid cross section, which is in agreement with a more recent angular representation of soil capillaries. Owing to small dimensions of microfluidic channels, colloid retention can be visualized at the scale of a single colloid. In this study, the emphasis is given to the hydrodynamic effects on colloid retention in the interfacial region.

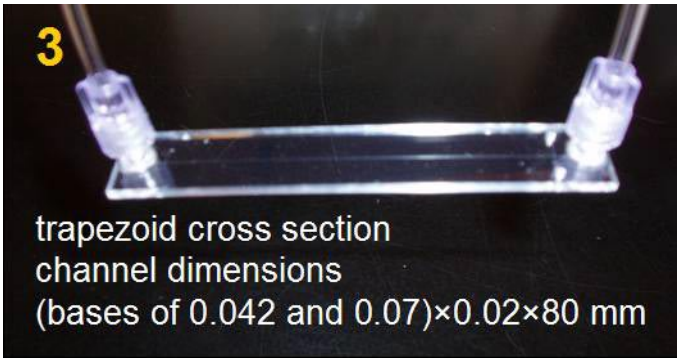

Figure 3. Photograph of a microfluidic channel.