Behavior of colloidal suspensions flowing through microchannels

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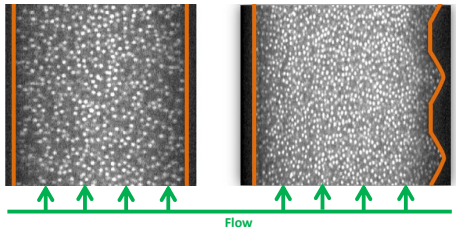
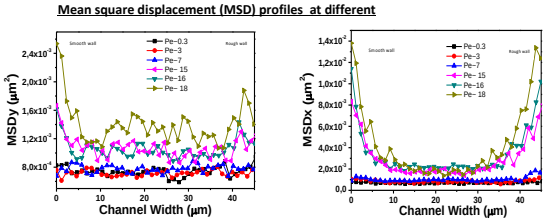
Abstract: We studied the diffusive behavior of hard sphere colloidal suspensions inside micro channels at different flow rates. We use CSLM to image 1 μm silica spheres (FITC fluorescence in the core) suspended in Glycerol-water solvent mixture. At rest, the diffusive behavior is similar to the bulk diffusion but it gradually changes while increasing the flow rates. We also improved the method to subtract the velocity profile and measure the diffusivity of the particles. Due to the convection, diffusion becomes anisotropic and it becomes prominent around Péclet number (Pé) 10. At rest, the diffusivity is lower closer to the wall up to few particle diameters but at higher flow rates, the diffusivity closer to the wall is significantly higher than away from the wall (see the graphs below). We argue that the enhancement of the diffusivity closer to the wall is due to the effect of shear. And the variance of the diffusivity across the channel width is due to the presence of the shear gradient inside the channel.



Micro channel with smooth side walls

Micro channel with rough side wall



Mean square displacement normal to the flow direction

Mean square displacement along the flow direction