Diffusio-phoresis of photocatalytic particles under self-generated concentration gradients

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The generation of flow within the interfacial structure due to concentration gradients was described quantitatively for the first time by Anderson [1] and extended by Ajdari and Bocquet [2] for solvophobic surfaces. The flow is driven by an osmotic pressure gradient which builds up inside the interfacial layer where the interaction potential between the chemical species and solid spans (Figure 1). Moreover, if the surface is reactive, the diffusio-osmotic flow could be promoted without any external input, through self-generated concentration gradients. If the solid surface is not immobilized, e.g in a colloidal system, the surface flow will propel small particles.

In this project, the migration of photocatalytic particles (TiO_2) under self-generated concentration gradients is studied systematically in a microreactor where an aqueous solution of an organic contaminant is contacted under continuous flow with a particle suspension containing various concentrations of the same contaminant (Figure 2). When UV light is turned on, the photocatalytic particles decompose the contaminant lowering the concentration inside the colloidal stream. The difference in concentration that is generated via the photocatalytic reaction leads to the migration of particles toward the higher concentration site.

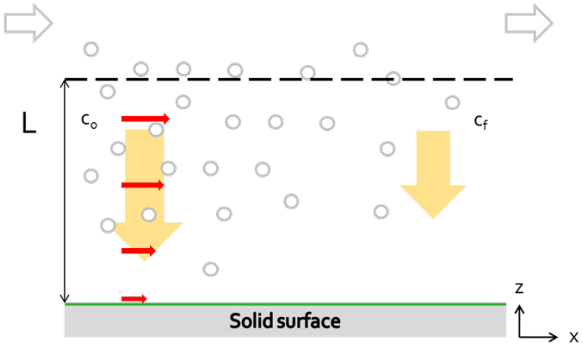

Figure 1 Concept illustration for diffusio-osmosis.

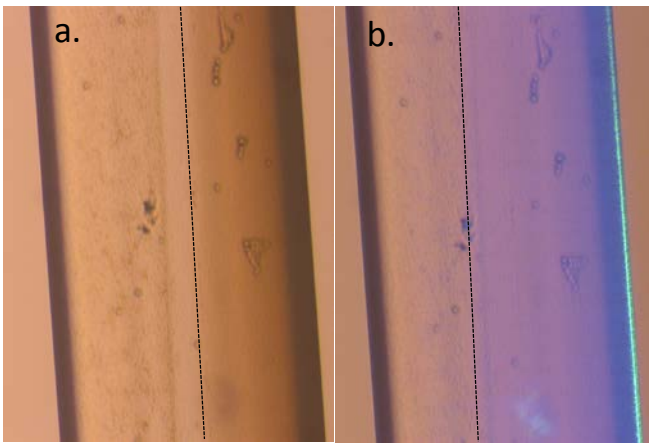

Figure 2: A methylene blue (MB) solution is contacted with a TiO_2 suspension stream containing the same MB concentration in a 200 µm width channel. The dotted line is used as a guideline to show the spreading of the colloidal stream upon illumination. **a.** UV off; **b.** UV on.

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[1] J. L. Anderson, *Annu. Rev. Fluid Mech.*, 1989, **21**, 61.
[2] A. Ajdari and L. Bocquet, *Phys. Rev. Lett.*, 2006, **96**, 1.