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Enriched boundary layers for heterogeneous reaction in stirred microfluidic flows JOSEPH KIRTLAND, ABRAHAM STROOCK, Department of Chemical and Biomolecular Engineering, Cornell University — The rate of transport of a scalar from a fluid stream to a reactive surface depends on both the character of the flow and the scalar concentration profile incident on the surface. Uniaxial flows tend to form thick regions of low concentration near the reactive surface, leading to decreased rates of scalar transport. For irreversible reactions, this effect can be mitigated through efficient mixing of the bulk. This ensures that the average concentration is incident on the reactive surface, and that concentration boundary layers are kept thin.[1] Coupled reversible reactions, such as those occurring at the electrodes of an electrochemical cell, can complicate the analysis of such a system. In a stirred microfluidic electrochemical cell, depletion of the reactant of the forward reaction implies enrichment of the reactant of the reverse reaction. This enriched fluid can bypass the well mixed bulk, leading to increased scaling of the overall transport process with the Péclet number *Pe*, even in cases of efficient bulk mixing. We present numerical and experimental results in several such flows and discuss situations where this enrichment can be beneficial (amplification in sensors) or detrimental (quantitative concentration measurement).

[1] J. Kirtland, G. McGraw, A. Stroock. *Physics of Fluids* **18**, 073602 (2006).

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