Abstract Submitted
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Transport limits on dissolution from a spinning disk – effects of instabilities in the flow[1] ZIYAO LIU, ANTHONY LADD, University of Florida — A rotating disk is the "gold-standard" experiment for measuring surface reactions rates. Von Karman derived an exact solution of the Navier-Stokes equation around an infinite disk and Levich later solved the corresponding mass transport equation; then the connection between surface concentration and bulk concentration could be calculated analytically. Levich's derivation involved a number of assumptions: laminar flow, uniform radial concentration, and dilute solutions. Our simulations of a spinning disk experiment found that the flow is unstable at surprisingly small rotation rates (<10 rpm), well below the rates used in laboratory experiments (100 - 1000 rpm). We aim to determine how these instabilities might affect experimental measurements of surface reaction rates, particularly for more complex solutions where the ion concentrations are not necessarily small. Our simulations are finite volume based, using the OpenFOAM toolkit. I will present preliminary results for the rate of mass transfer from the disk at low rotation speeds. Our results start to deviate from literature predictions at about 30 rpm, where time-dependent oscillations in concentration flux were noticed. Currently we are validating our code for the "rotor-stator" problem, by comparing with spectral solutions.

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