Abstract Submitted
for the DFD10 Meeting of
The American Physical Society

Decay of a Passive Tracer in Two-Dimensional Turbulence-Application to Infinitely Fast Chemistry FARID AIT CHAALAL, PETER BARTELLO, MICHEL BOURQUI, McGill University, Montréal, Canada — We investigate the effect of diffusion (κ) on chemical production in a 2D turbulent flow using ensembles of direct numerical simulations (DNS). Assuming an infinitely fast chemistry between two initially unmixed reactants, the problem simplifies to studying the mean absolute value of the passive tracer ϕ defined as the difference between the concentrations of the two reactants. The reaction speed is dictated by the diffusive flux across an isoline of ϕ. The DNS show that production scales like $\kappa^{p(t)}$ where $p(t)$ is a positive decreasing function of time, during an initial transient period characterized by the exponential lengthening of the contact line. We show theoretically that this behavior of $p(t)$ is determined by the initial gradients along the contact line, with sharp gradients decreasing the effect of diffusion. The long time decay of the first moment of ϕ is exponential. At large Peclet number, the decay rate converges and the reaction speed is merely determined by the mixing. At small Peclet number (< 5000), the decay rate scales like $\kappa^{1/2}$, reflecting a purely diffusive behaviour.

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Date submitted: 07 Aug 2010 Electronic form version 1.4