Abstract Submitted
for the DFD13 Meeting of
The American Physical Society

Flame Thickness and Conditional Scalar Dissipation Rate in a Premixed Temporal Turbulent Reacting Jet SWETAPROVO CHAUDHURI, Indian Institute of Science, HEMANTH KOLLA, Sandia National Laboratories, EVATT HAWKES, The University of New South Wales, JACQUELINE CHEN, Sandia National Laboratories, CHUNG LAW, Princeton University — The flame structure corresponding to a lean H_2/air premixed flame in intense sheared turbulence in the thin reaction zones regime is quantified from flame thickness and conditional scalar dissipation rate statistics obtained from recent direct numerical simulation data of premixed temporally-evolving turbulent slot jet flames. The local alignment between the progress variable iso-surface normals and the most compressive principal strain rate is observed to increase traversing from the unburnt reactants to the burnt products. Such preferential alignment coupled with sub-unity Le associated with lean H_2/air mixtures results in increasing normalized mean conditional scalar dissipation rate and a resultant decrease of the normalized mean flame thickness. On average, these turbulent flames are thinner than their corresponding planar laminar flames. The intermittency of the conditional scalar dissipation rate is found to exhibit a unique non-monotonicity of the exponent of the stretched exponential function, conventionally used to describe probability density function tails of such variables. The non-monotonicity is attributed to the detailed chemical structure of hydrogen-air flames where heat release occurs close to the unburnt reactants at near free stream temperatures.

Swetaprovo Chaudhuri
Indian Institute of Science

Date submitted: 15 Jul 2013 Electronic form version 1.4