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Scalar power spectra and turbulent length scales in high-Schmidt-number scalar fields MOHAMMAD MOHAGHAR, Georgia Institute of Technology, LAKSHMI P DASI, The Ohio State University, DONALD R WEBSTER, Georgia Institute of Technology — This experimental study has investigated effects of Reynolds number ($5000 \leq Re \leq 20,000$) and initial release diameter ($2.2mm \leq D \leq 9.4mm$) on scalar power spectra and turbulent length scales of high-Schmidt-number passive scalar fields resulting from an iso-kinetic release in a turbulent boundary layer. The turbulence analysis is based on 12,000 scalar fields collected using the PLIF technique for each case at 6 locations downstream. Although the spectral slope at intermediate scales is found to increase to an asymptotic value higher than -5/3 farther downstream, there is an increase in spectral slope from approximately -1.5 for $Re = 5000$ to roughly -1.2 for $Re = 20,000$ while fixing the release diameter at 4.7 mm. A similar trend is observed for the effect of nozzle diameter on spectral slope, as it increases from almost -1.5 to -1.2 when the nozzle diameter changes from 9.4 mm to 2.2 mm while fixing $Re = 10,000$. The scalar integral scale and scalar Taylor microscales are calculated directly from the scalar fields using the correlation function. It was found that the Taylor microscale decreases and the integral scale increases to an asymptotic value respectively, farther downstream. This indicates a larger range of scales exists as flow becomes more turbulent.

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