Abstract Submitted
for the DFD20 Meeting of
The American Physical Society

Direct Numerical Simulations of Blended Ammonia/Hydrogen/Nitrogen Premixed Flames in Intense Sheared Turbulence[1] ANDREA GRUBER, SINTEF Energy Research, MARTIN RIETH, Sandia National Laboratories, YUNCHAO WU, TIANFENG LU, University of Connecticut, JACQUELINE CHEN, Sandia National Laboratories — Ammonia is being considered as an attractive carbon-free energy carrier. While hydrogen presents a promising carbon-free natural gas replacement, ammonia offers advantages in terms of storage and transport. Challenges, however, include neat ammonia not providing suitable flame properties (e.g., flame speed) and the generation of NOx pollutants. Ammonia flame properties can be adjusted by partial fuel cracking to provide an ammonia/hydrogen/nitrogen mixture. For ammonia/hydrogen/nitrogen blends, the amount of NOx released strongly depends on equivalence ratio. A fundamental understanding of turbulent flame properties and NOx generation mechanisms of such blends in turbulent conditions is still missing. We address this using Direct Numerical Simulations of temporally-evolving turbulent sheared flames at different equivalence ratios and pressures. In addition, we compare a baseline case to a case with natural gas (i.e., methane) at nominally similar conditions, highlighting differences in turbulent flame behavior. A statistical comparison of the cases is presented in terms of their displacement speeds, flame surface density statistics and chemical explosive mode analysis highlighting relevant chemical pathways and combustion modes.

[1]Sponsored by Sandia, SINTEF and OLCF INCITE

Martin Rieth
Sandia National Laboratories

Date submitted: 10 Aug 2020 Electronic form version 1.4