College of Engineering
Department of
Mechanical & Industrial Engineering

The Sidney E. Fuchs Seminar Series

3:30-4:20pm, Friday, September 19th, 2014
Frank H. Walk Design Presentation Room

Fundamental Experiments for the Study of Propellant and Fuel Combustion Chemistry

by Eric L. Petersen*

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Experiments are ongoing in the speaker's laboratory to study the ignition, oxidation, and flame chemical kinetics of hydrocarbon-, nitrogen-, and hydrogen-based mixtures at conditions representative of those seen in rocket and gas turbine applications. Representative conditions herein imply elevated pressures (10 atm and higher), temperatures, and fuel blends. The ignition tests are conducted in the available low- or high-pressure shock tubes with the capability of achieving reflected-shock pressures as high as 100 atm, and laminar flame speed experiments are conducted in either of two, constant-volume test rigs with optical access. Details on the shock-tube and flame speed facilities will be given, including the optical diagnostics employed therein. Although much work has been done on hydrogen-based and C_1-C_5 hydrocarbon oxidation through the years, few data existed prior to the speaker's recent studies for such a comprehensive range of fuels, fuel blends, and conditions. However, arguably less attention has been paid by the combustion kinetics community to propellant-related chemical kinetics. Over the past few years, work from the Petersen Group has included new data for nitrogen-based compounds such as N_2O, NO_2, and NH_3 which have led to an updated nitrogen oxidation chemistry sub-mechanism. Ongoing work includes a study of nitromethane oxidation and the development of heterogeneous techniques in both the flame speed and shock-tube experiments. Details and results related to propellant chemistry that have been performed in the speaker's laboratory will be presented. An overview of the overall research activities in the speaker's group will also be given, including heterogeneous propellant studies.

* Dr. Petersen is presently the Nelson-Jackson Professor in the Department of Mechanical Engineering at Texas A&M University. He received his Ph.D. in Mechanical Engineering from Stanford University (1998), his M.S. in Mechanical Engineering from the University of Florida (1990), and his B.S. in Mechanical Engineering from the University of Central Florida (1988). After receiving his M.S. degree, he worked for three years as an Analytical Engineer in the combustion group at Pratt & Whitney (1990-'93), where he performed fluid and thermal analyses and experiments in support of advanced gas turbine and rocket combustor technologies. Dr. Petersen was a staff scientist at The Aerospace Corporation in the Propulsion Science Department from 1997 to 2001. During his period at Aerospace, Dr. Petersen was also an instructor in the Mechanical and Aerospace Engineering department at the University of California, Irvine. Dr. Petersen has been at Texas A&M University since January 2008. Prior to his current position at TAMU, Dr. Petersen was an Assistant and then Associate Professor in the Mechanical, Materials and Aerospace Engineering department at the University of Central Florida (2001-07). His research has been in the fields of gas dynamics; propulsion; combustion; shock wave physics and chemistry; chemical kinetics; optical diagnostics and spectroscopy; combustion instability; fluid mechanics; nano-additives; and solid rocket propellants. He has authored over 300 journal and conference papers in these areas.