IOWA STATE UNIVERSITY
Department of Mechanical Engineering

Propellant Combustion Chemistry from Several Angles: Nitromethane Oxidation, Pyrolysis, and High-Pressure Burning Rates

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Seminar host: Travis Sippel

Abstract

Nitromethane (NM) is recently receiving a lot of attention in the combustion community for a variety of reasons: from a pure fundamental research viewpoint, since NM can help in understanding the mutual sensitization between hydrocarbons and NOx, to very practical applications as NM can be used as a monopropellant, automotive fuel additive, or even for race and modeling engines. Nitromethane is also a model liquid monopropellant that is relatively easy to work with in a laboratory setting, particularly when exploring the effects of various solid additives on liquid propellant burning rates. Over the past several years, the Petersen Group has studied nitromethane combustion over a range of conditions and using several different facilities and diagnostics ranging from shock tubes with laser absorption spectroscopy to high-pressure strand burners with high-speed imaging. With regard to chemical kinetics, the recent literature on nitromethane combustion exhibits discrepancies between experimental results and models coming from different groups. To identify and reduce these discrepancies, new time history profiles of H2O and CO were obtained by laser absorption techniques in shock tubes. Modern detailed kinetics models capture this unique time-history profiles but could still be improved. High-pressure burning rate measurements are also detailed in this talk, where nitromethane was studied as a pure propellant and as a heterogeneous mixture of liquid and organometallic additives. Details of the various facilities and capabilities of the Petersen Group at Texas A&M University are also highlighted.

Dr. **Eric 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 390 journal and conference papers in these areas.

This seminar counts towards the ME 600 seminar requirement for Mechanical Engineering graduate students.

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