הטכניון מכון טכנולוגי לישראל TECHNION Israel Institute of Technology

Faculty of Mechanical Engineering הפקולטה להנדסת מכונות

Mechanical Engineering Seminar

Monday, February 5th, 2024, at 14:30, D. Dan and Betty Kahn Building, Room 217

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Towards an Environmentally Sustainable Future: Cool flames and Novel Combustion Technologies

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Hosted by: Prof. Alon Wolf

As global consensus on the critical need to mitigate greenhouse gas emissions and combat anthropogenic climate change grows, there is an urgent imperative to study the fundamentals of low-temperature combustion. This research is essential not only to improve the thermal efficiency of systems in the energy and transportation sectors but also to pave the way for the development of innovative technologies grounded in low-carbon and carbon-neutral fuels. While high-temperature combustion and hot flames have been extensively studied for decades, a new frontier in combustion science has emerged—low-temperature combustion and cool flames, with only a few research groups worldwide actively investigating this field. Our research on high-pressure cool flames led to the discovery of a new pressure-dependent relation for the cool flame heat release rate. This finding, distinct from the well-established pressure-independent relation of hot flames, emphasizes the profound influence of pressure on cool flames. Furthermore, I will introduce the radical index theory for high-pressure cool flames, offering a quantitative measure of the low-temperature reactivity of fuels. This measure serves to assess the suitability of existing or newly synthesized fuels for advanced propulsion technologies based on low-temperature combustion. Finally, I will present a new understanding of the kinetic enhancement effect in the deflagration to detonation transition (DDT), allowing acceleration of the shock-ignition coupling and the detonation transition. The insights gained from this research are significant to further develop new methods based on ignition enhancers such as plasma-assisted DDT because DDT acceleration is crucial for eliminating detonation stability and reducing heat losses, leading to improved combustion efficiency and enhanced thermodynamic cycles by up to 30%. This seminar aims to shed light on the pivotal role of low-temperature combustion in the ongoing global effort to address climate change. Through our research, we contribute valuable insights that have implications for both fundamental combustion science and the practical development of environmentally sustainable technologies.

Andy Thawko has been Postdoctoral Research Fellow at Princeton University since 2022. His research interests focus on the fundamental understanding of complex reacting flows and low-temperature combustion to develop advanced technologies for clean energy generation. Andy completed his Ph.D. in 2021 at the Grand Technion Energy Program, conducting research in the Faculty of Mechanical Engineering. Prior to this, he earned his M.E. in Energy Engineering in 2013, and his B.S. in Mechanical Engineering in 2009, both from the Technion.

Seminars Coordinator: Assoc. Prof. Gal Shmuel