DCSI Webinar, Friday February 24, 2023, 13:00-14:00 CET
Zoom link available upon request from combustioninstituteNL@gmail.com
and announced via LinkedIn:
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The unique problems of iron-dust combustion and its applications

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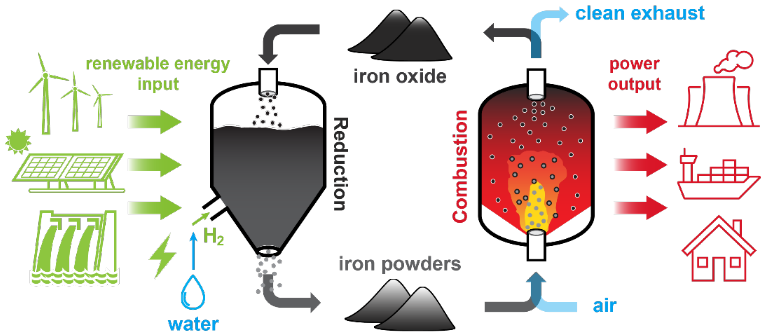

Metal-enabled Cycle of Renewable Energy (MeCRE)

Abstract

Iron is an excellent fuel for long-term storage and long-distance transport of clean energy owing to its carbon-free nature, high energy density, and potential of non-volatile combustion in air. Iron power is now considered as the most promising candidate to establish a **Metal-enabled Cycle of Renewable Energy (MeCRE)** on a global scale. An iron-dust combustor for power generation lies at the heart of the development of MeCRE. To build and optimize such a combustor, although a decent amount of knowledge in the combustion of conventional solid (or liquid) fuels is useful, numerous ***unique*** questions rooted in iron-dust combustion must be answered. First, owing to their high boiling point, iron particles remain mostly in condensed phases during the combustion process. This heterogeneous nature makes the combustion behaviors of iron particles intrinsically different from volatile solid fuels, e.g., coal, biomass, and aluminum particles. A better understanding of the unique physics underlying the oxidation of iron particles provides us with a foundation for accurately calculating the heat release rate (HRR) of iron-dust flames. In the first part of this webinar, a thorough overview of the experimental and theoretical efforts devoted into the fundamentals of iron-particle oxidation is presented. Another important feature of iron-dust flames is their spatial non-uniformity. The non-volatile nature of iron combustion results in a heat release initially concentrated at each particle, giving rise to a spatially discrete flame propagation behavior. This non-uniform picture is likely further complicated when iron particles burn in a turbulence (at application-relevant conditions)—particle clustering occurs in a regime of high Stokes number (Stk~10-100) due to the high density of iron. Challenges and ongoing efforts made towards understanding the highly non-uniform nature of iron-dust flames are elucidated in the second part of this webinar.

Short CV

XiaoCheng Mi is an assistant professor at the Power and Flow group in the Mechanical Engineering Department of Eindhoven University of Technology (TU/e). He received his PhD degree in Mechanical Engineering at McGill University (Canada) in May 2018 under the supervision of Prof. Andrew J. Higgins. His doctoral dissertation is on "*Detonation in spatially inhomogeneous media*". From Aug. 2018 to Feb. 2020, he was supported by the Canadian NSERC Postdoctoral Fellowship to pursue a postdoctoral study on detonation of multiphase energetic materials at the Centre for Scientific Computing (CSC), Cavendish Laboratory, University of Cambridge (UK). From Mar. 2020 to Oct. 2021, XiaoCheng did his second postdoctoral research on metal combustion at the Alternative Fuel Laboratory (AFL), McGill University, directed by Prof. Jeffrey M. Bergthorson. He is a member of the Combustion Institute (Int. and Canadian Section) and the American Physical Society (APS). He received the *John H.S. Lee Young Investigator Award* at the 27th International Colloquium for Dynamics of Explosions and Reactive Systems (ICDERS) in 2019. He is also an organizer of the Young Researchers' Forum on Detonation (YRF-Det) and the 1st Workshop on Metal-enabled Cycle of Renewable Energy (MeCRE) at TU/e in November 2022.