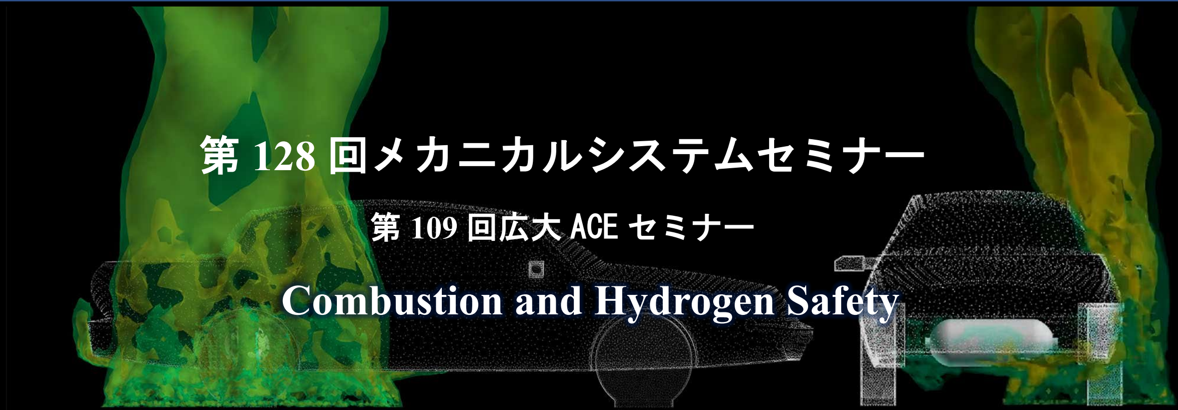

第 128 回メカニカルシステムセミナー

第 109 回広大 ACE セミナー

Combustion and Hydrogen Safety

日　　時	2022 年 10 月 5 日（木）　17:00－19:00（日本標準時）
場　　所	オンライン（Online）
URL	128_Mechanical_System_Seminar
講　演　者	Prof. Vladimir Molkov, Hydrogen Safety Engineering and Research Centre (HySAFER), Ulster University, UK

Professor at Ulster University, Director of Hydrogen Safety Engineering and Research Centre (HySAFER), one of key providers of hydrogen safety research and education globally. MSc Quantum Radiophysics, PhD Chemical Physics, DSc Fire and Explosion Safety. Member of: UN Global Technical Regulation for Hydrogen and Fuel Cell Vehicles GTR#13; ISO/TC197 Hydrogen Technologies; CEN/CLC/JTC6 Hydrogen in Energy Systems; BSI PVE/003/08 Gas containers - Hydrogen technologies; Hydrogen Europe Research, European Hydrogen Safety Panel, 6 journal editorial boards, 4 conference committees. Fellow of the Energy Institute, Chartered Engineer (CEng) with Engineering Council, Fellow of Higher Education Academy, Chair of the Education Committee of International Association for Hydrogen Safety. Coordinated and contributed to 33 UK and European projects in hydrogen safety worth more than £10M, 360+ publications, including free download e-book "Fundamentals of Hydrogen Safety Engineering" recently translated to Chinese, 15 inventions, including explosion free in fire self-venting (TPRD-less) high-pressure hydrogen storage tank.

講演タイトル	Combustion and Hydrogen Safety
講演概要	次ページの Abstract をご参照下さい.
申込方法	次のリンクにご記入下さい.　https://forms.gle/Zm4yjjttCtTJmWiG6
参　加　費	無料

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Abstract

This lecture overviews some problems of hydrogen safety addressed by research at HySAFER Centre. While combustion is well-established discipline, hydrogen safety is emerging multidisciplinary area that heavily relies on results of studies in reacting flows. The few tools of the e-Laboratory of Hydrogen Safety are briefly introduced along with the details of free access to the laboratory. Examples of tools are: dimensionless flame length correlation; pressure peaking phenomenon; blast wave decay after hydrogen tank rupture in a fire. An example of forthcoming tool is presented: blast wave after delayed ignition of under-expanded hydrogen jet.

Mechanism of spontaneous ignition of sudden hydrogen release is explained using results of numerical simulations using the CFD model validated against experiments.

Indoor hydrogen jet fire regimes are investigated and dynamics of hydrogen fire in vented enclosure is demonstrated by videos for different conditions of release and ventilation.

The results of CFD analysis of blast wave and fireball bahaviour after hydrogen tank rupture in a fire in the open atmosphere confirmed the importance of hydrogen reaction with air at the contact surface as a contributor to the blast wave strength. The dynamics of blast wave and fireball after tank rupture in the open are compared to that in a tunnel. The correlation for blast wave decay after hydrogen storage tank rupture in a tunnel fire developed at Ulster and validated by CEA experiments is presented. It is concluded that tank rupture in a tunnel must be excluded by all means.

Safety concerns about fire test protocol of the Global Technical Regulation on Hydrogen and Fuel Cell Vehicles No.13 are explained.

The first ever model for tank-TPRD (thermally activated pressure relieve device) system design in case of engulfing fire is introduced. The research demonstrated that standard Type IV tanks with HDPE liner would not rupture in fire but leak through the composite wall after melting the liner if the State of Charge of hydrogen tank is below about SoC<50% (depends on the tank parameters).

Underground parking safety strategy for hydrogen-powered vehicles is formulated. It is built on exclusion of formation of hydrogen flammable cloud under the ceiling (to prevent destructive deflagration), and limitation of combustion products temperature under the ceiling below 300ºC. This can be achieved by either reduction of TPRD diameter or by use of self-venting tanks without TPRD.

Finally, the breakthrough safety technology of explosion free in fire self-venting (TPRD-less) tank for hydrogen storage is explained. This safety technology allows to achieve unprecedented level of safety:

- No blast wave!
- No fireball!
- No projectiles!
- No long flames!
- No pressure peaking phenomenon in confined spaces!
- No fatalities and property loss due to tank rupture!

This innovative engineering solution opens the way of inherently safer storage of hydrogen onboard of vehicles, at hydrogen refuelling stations, in confines spaces like tunnels and underground parking, and in hydrogen storage rooms on trains, ships, and planes.