Ishimoto and Oshima Laboratory

(Institute of Fluid Science, Tohoku University, Innovative Energy Research Center, Multiphase Flow Energy Laboratory)

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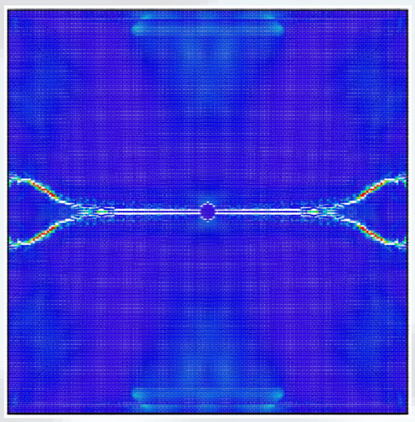
Multiphase Flow Energy Lab.

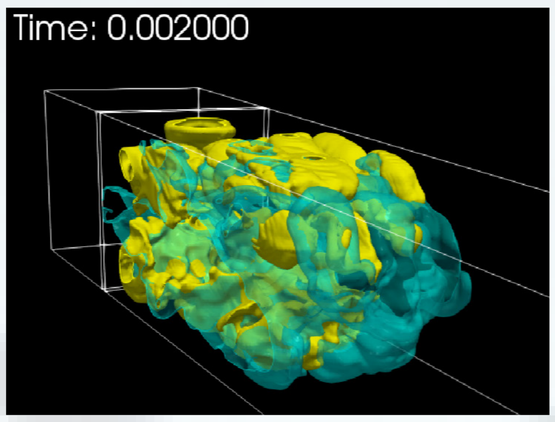
Research outline:

Our laboratory is focusing in the development of innovative multiphase fluid dynamic methods based on the multiscale integration of massively parallel supercomputing and advanced measurements, and research related to creation of environmentally conscious energy systems. Furthermore, we promote basic research for the creation of risk management science and associated new multiphase flow system directly linked to sustainable energy represented by a high-density hydrogen storage technology. Particularly, we are focusing in different field integration research and development such as creation of environmentally conscious type nano-cleaning technology using reactive multiphase fluid that is a thoroughly chemical-free, pure water free, dry type semiconductor wafer cleaning system using cryogenic micro-nano-solid high-speed spray flow, and also focusing on removal-reusing technology for solar cells and ITO membranes for conducting organic polymer (including indium oxide tin). We also performed computational study of multiple bubbles behavior in megasonic field to clarify the mechanism of particle removal by megasonic cleaning. Furthermore, aiming to contribute disaster risk science field, fundamental mitigation effect of mega-floating structures on the water level and hydrodynamic force caused by the offshore tsunami has been computationally investigated using SPH method taking into account the fluid-structure interaction (FSI).

マルチスケール異分野融合型混相エネルギーシステムの創成

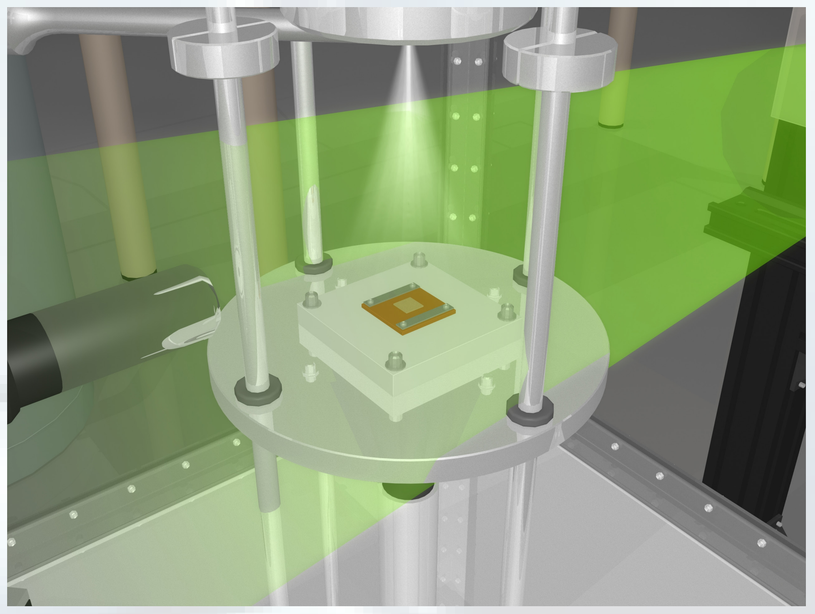
Development of Integrated Multiscale Multiphase Flow Energy System


Crack propagation by particle method



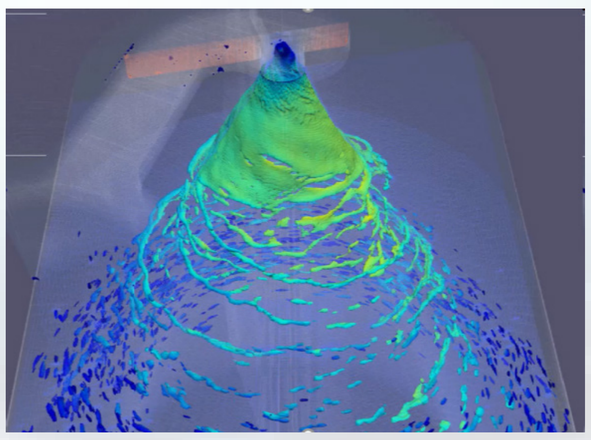
Instantaneous isosurfaces of H_2 mass fraction and OH mass fraction

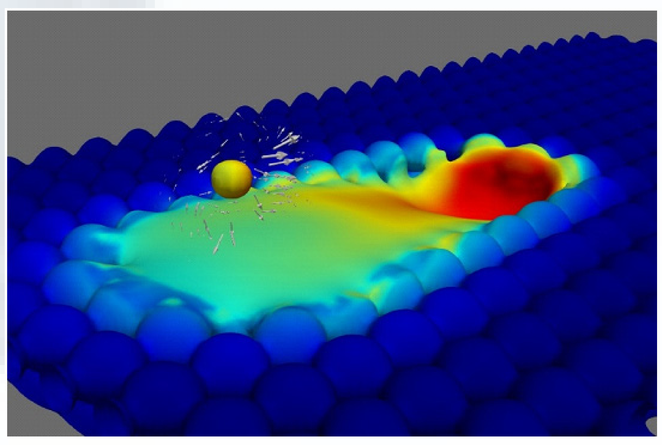
高圧水素タンク隔壁に発生したき裂伝ぱ挙動と着火を伴う反応性漏えい水素の拡散挙動に関する流体ー構造体連成コンピューティング
Fluid-Structure Coupled Computing of Crack Propagation Behavior in a High-Pressure Hydrogen Tank Bulkhead and Diffusion Behavior of Reactive Leaking Hydrogen with Ignition

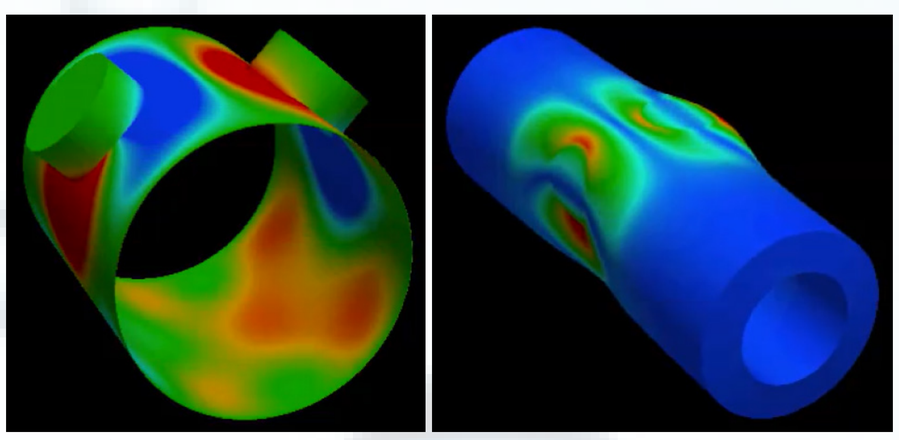

極低温ファイン固体粒子噴霧を用いたナノデバイスクリーニング
Nano device cleaning using cryogenic fine solid particulate spray

自動車部品生産技術に対する混相流体力学的アプローチ

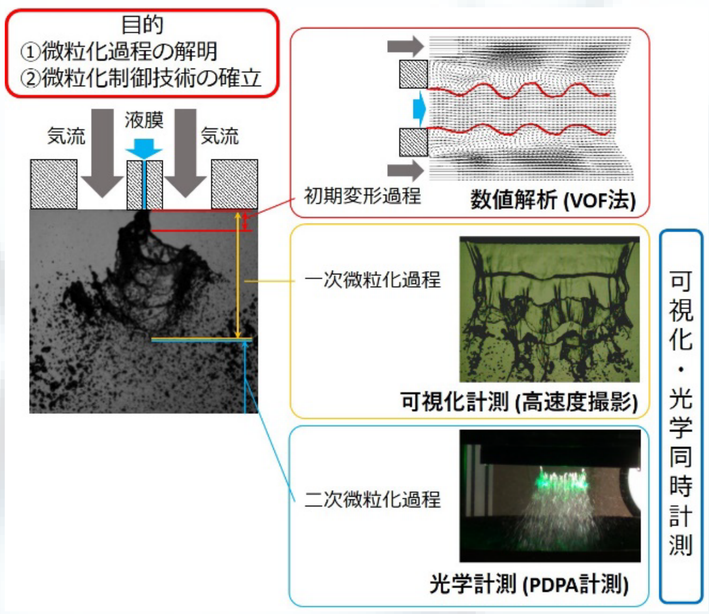
Multiphase Fluid Dynamic Approach to Automotive Component Production Technology


スワールインジェクターの微粒化プロセスに関するスーパーコンピューティング
Supercomputing of swirl injector atomization process


3D printer用金属粒子のレーザー溶融プロセスとプパッタ粒子発生メカニズム
Laser melting process of metal particles for 3D printer and mechanism of spatter particle generation


エンジン用Piston-pinとコンロッド間弾性流体潤滑に関する流体ー構造体連成解析
The pressure contour and elastic deformation behavior of piston-pin by FSI elastohydrodynamic computing

自動車部品の生産技術に関する先端混相流体力学的アプローチを実施し，インジェクタースプレー微粒化メカニズム，3Dプリンタ内微粒子のレーザー溶融現象，エンジン用ピストンーコンロッド間のトライボロジー現象等に関するスーパーコンピューテイング手法を開発している．
We are developing advanced multiphase hydrodynamic approaches to automotive component production technology. These include injector spray atomization mechanisms, laser melting of fine particles in 3D printers, and tribological phenomena between pistons and engine connecting rods.



ガスタービンの革新的燃料噴射技術の開発

Development of Innovative Fuel Injection Technology for Gas Turbines

微粒化過程の素過程と各過程の相互作用に着目し，数値解析，可視化計測，光学計測や理論解析を協調して行うことで，気流による液膜微粒化過程の解明と微粒化制御技術の確立を目指している．
By focusing on the elementary processes of the atomization process and the interaction of each process, we aim to elucidate the liquid film atomization process by airflow and to establish atomization control technology by coordinating numerical analysis, visualization measurement, optical measurement and theoretical analysis.