理工学研究所
国際交流・公開研究セミナー

Dr. Laurent Berthe（フランス国立科学研究センター）が来日される機会に，レーザー誘起プラズマによる衝撃波を利用した材料強度に関するご講演をお願いしました．是非ご参集ください．

題　目：　Shock produced by laser plasma for material science and engineering. New advances in process control and impact for applications.
講演者：　Dr. Laurent Berthe
（フランス，フランス国立科学研究センター）
日　時：　2024 年　11 月　15 日（ 金 ）　13:00 – 14:30
場　所：　中央大学 後楽園キャンパス 6 号館 4 階　6410 号室

アブストラクト:

When a ns laser pulse is focused on the surface (>GW/cm^2), a high pressure plasma (>GPa) is generated. In reaction, a shock wave is induced in material which can be used for mechanical testing at high strain rate, laser shot peening, Laser Adhesion Test (LASAT)and laser damaging. For applications, target is covered by transparent layer to confine plasma and reach higher pressure compared to direct regime.

For the most sensitive application, industrial deployments are limited by the control of source term and the behavior of materials under shock. The first part of the seminar will focus on our last advances in these two issues. Efforts have concerned laser beam loading control and the modeling of laser plasma generation. The hydrodynamic/plasma ESTHER code has been experimentally validated in the current process parameters ranges of applications giving microscopic parameters of the plasma for the first time. Effort has been done to develop a global methodology from laser metrology to plasma characterization and modeling. Engineering scaling laws (pressure and temperature) have been extracted that could be used as boundary conditions for mechanical codes in routine. Besides, modeling has been also concerned with the specific configuration of small laser spot without thermal coating. Results have demonstrated that pressure loading is reduced due to fast plasma release under 1 mm spot size (for 10 ns pulse duration) allowing also scaling law for process optimization. Polymer transparent material has been discovered for confinement, opening new fields of applications.

This ultra-fine knowledge of mechanical loading has allowed for example the identification of the parameters of the JC cook model of well-known alloys (7075 and 2017) and unknown materials (FSW assembly of the two). Discussions have been done in relation with microstructure of the material.

The second part of the seminar will concern new advances on applications. It addresses issues fort LASAT applied to CFRP bonding and painting as well as dismantling of composite structures at the end of life. Recent works have been demonstrated the sensitivity of the technique to ageing. Effort was also made on laser shot peening in the development of optimization tools and new lasers. These results are open to allow industrial opportunities and collaborations.

The third part of the seminar will discuss new challenges and applications. Some will concern the use of laser shock produced by plasma to reproduce hyper impact damage for space debris applications. All publications in relation will be linked for download and discussions.

講演終了後の夕方に懇談会を予定しております．（17:30 から　2631 室）

連絡先：中央大学理工学部精密機械工学科
米津明生