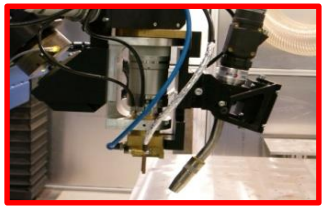
Hybrid Welding

LASER-ELECTRIC ARC: hybrid laser/arc welding offers many advantages, if compared to laser or arc welding, such as an increase of welding speed, weldable thickness, gap bridgeability and stability of the process, with a weld bead quality very similar to a laser welding process.



LASER-ARC WELDING

FSW-LASER: the Friction Stir Welding (FSW) is a solid state welding by friction and mixing, which does not need any filler material or shielding gas. These characteristics allow to weld aluminum alloys (2xxx, 5xxx, 6xxx, 7xxx, 8xxx) and alloys of different series (5000/6000, 2000/7000). The limitations of the FSW technology for steel or steel-aluminum are related to high temperatures and forces required by the process, which can be reduced using a laser source.

FSW-LASER WELDING

FSW-ELECTRIC ARC: the coupling of FSW and electric arc provides an improved resistance to corrosion of the joints. Moreover an increase of fatigue resistance and a general improvement of the weldability have been detected either in homogeneous joints or in heterogeneous joints (aluminum-copper) welded using combined FSW/arc.

FSW-ARC WELDING

Technologies Supply

WELDING TECHNOLOGIES
HYBRID WELDING TECHNOLOGIES
DIAGNOSTIC OF WELDED JOINTS
TECHNOLOGY TRANSFER
CONSULTING

The TISMA laboratory is focused to stimulate the development of new skills, processes and technologies vital for the regional economy and for the industrial fields. The research activities are founded on welding processes such as laser, electric arc with low and high intensity (Capacity Discharge Welding), and using the heat generated by friction (Friction Stir Welding). Combining simultaneously these welding sources a wide range of new materials, with low weldability and difficult to weld with traditional welding techniques, could be welded in homogeneous and heterogeneous joints. The skills of the research team are available for the big regional industries and small/medium companies interested to the applied researches for production systems, testing and controls.

Contacts

TISMA Laboratory
Scientific Coordinator: Prof. Eng. A.D. Ludovico
Department of Mechanics, Mathematics and Management - Viale Japigia 182, 70126 – Bari
Tel.: +39 0805962755
e-mail: antoniodomenico.ludovico@poliba.it
URL: www.dimeg.poliba.it/tisma

UNIONE EUROPEA
Fondo Europeo di Sviluppo Regionale
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MINISTERO DELLO SVILUPPO ECONOMICO
MINISTERO DELL'UNIVERSITA' E DELLA RICERCA
MINISTERO DEL LAVORO, SALUTE E POLITICHE SOCIALI

REGIONE PUGLIA

Network of Laboratories

Laboratory of Innovative Techniques for Advanced Materials Welding

SCIENTIFIC COORDINATOR

Prof. Eng. Antonio D. LUDOVICO

POLITECNICO DI BARI

POLITECNICO DI BARI
Department of Mechanics, Mathematics and Management

UNIVERSITÀ DEL SALENTO
Department of Engineering for Innovation

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TISMA LABORATORY - R.U.1

SCIENTIFIC DIRECTOR: Dr. Eng. G. Casalino
giuseppe.casalino@poliba.it

HYBRID WELDING LAB.
FABRICATION OF WELDED JOINTS WITH HYBRID TECHNOLOGIES

Hybrid Laser/Arc, Friction Stir Welding/Laser and Friction Stir Welding/Arc welding of innovative and high performance materials (refractory metals, light alloys, sintered metals, metals, shape memory alloys, titanium, etc.).

FIBER LASER GMAW, GTAW

FRICTION STIR WELDING

5 AXIS WELDING STATION

A hybrid welding is the union of two different welding technologies finalized to synergic effects: the maximization of the technological limits of weldability and the optimization of the advantages of the single source welding technology for high performances applications. The target is to investigate the weldability of advanced materials and heterogeneous joints using laser, electric arc, and Friction Stir Welding (FSW) combined and stand alone.

EQUIPMENTS OF THE TISMA LAB. R.U.1

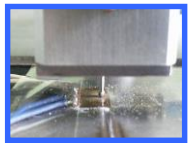
- **Laser Fiber Ytterbium source (4kW)**
- **Laser/Arc Hybrid Welding Station (CNC - 5 axis)**
- **Hybrid Welding Station FSW/Laser & FSW/Arc (3 axis – 18kW)**
- **MIG/MAG Generator (500A)**
- **TIG Generator (500A)**

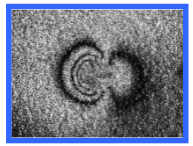
TISMA LABORATORY - R.U.2

SCIENTIFIC DIRECTOR: Dr. Eng. C. Casavola
caterina.casavola@poliba.it

RESIDUAL STRESS LAB.
CHARACTERIZATION OF WELDED JOINTS

Residual stress (RS) develops during manufacturing processes as a result of heat and mechanical treatment experienced by the material. Welding process generates RS in welded parts and this could lead to some problems in terms of dimensional stability and structural integrity.
Under working condition, the RS combines with the stress field produced by external loads, changing the distribution of stress and influencing the structural stability and resistance to fatigue and fracture of the structure. The experimental evaluation of the RS (really difficult to predict) is very important for a proper design.





Complete equipment for RS measurement on real welded components are available. We are able to perform measurements on site.

EQUIPMENTS OF THE TISMA LAB. R.U.2

- **X-Ray Diffractometer**
- **Stereomicroscope**
- **Thermal Imaging Camera**

The equipments of the Residual Stress Lab.–R.U.2 TISMA could be integrated with some equipments of the EMILIA Lab. and with other systems under development:

- **Hole Drilling Method**
- **Electronic Speckle Pattern Interferometry**
- **Barkhausen Noise**

TISMA LABORATORY - R.U.3

SCIENTIFIC DIRECTOR: Dr. Eng. F. W. Panella
francesco.panella@unisalento.it

CAPACITOR DISCHARGE WELDING
STATIC /FATIGUE MECHANICAL TESTING

In the UR3 unit, the research is based on welding methods with CDW technology, using Capacitor Discharge machine and non destructive controls based on ultrasound techniques to analyze the weld quality.

Static and fatigue tests are executed on welded specimens in different loading conditions, for both hybrid technology and CDW welded joints. Statistical analysis of experimental data.

EQUIPMENTS OF THE TISMA LAB. R.U.3

- **Axial/Torsional Fatigue Testing Machine**
- **Capacitive Discharge Welding Machine**
- **Ultrasonic CND weld inspection system**
- **Measure of stresses and strains with optical fiber sensors FBG (Fiber Bragg Grating)**
- **Electrical Resistance Strain Gauges**