

# PhotonHub Experience Centre

Laser based manufacturing: welding of metals and advanced surface patterning

## Course Provider

AIMEN Technology Centre,  
Spain

# Course Overview

Surface properties play an important role in the interaction between a component and its surrounding environment: wear resistance, wettability, corrosion resistance, optical properties or aesthetic aspect are some typical examples. Additionally, laser welding of metals reaches a wide variety of applications, sectors, and materials configuration. In all cases, process monitoring and quality control are very important topics in order to fulfill high quality standards and ensure process robustness.

This three-day hands-on training course provides industry, especially those addressing material processing, with a detailed overview of possibilities brought by lasers in the fields of laser welding and surface functionalization, and technical aspects that should be considered to select your equipment and setup your process. In addition, the course will provide an overview of sensors and tools to analyse the laser beam, monitor the welding process, as well as an overview of different characterization techniques to evaluate the functional behaviour of the laser-patterned surfaces.

This unique industry 'hands-on' training program provides attendees with access to state-of-the-art facilities, materials and a wide range of equipment (high power continuous wave and pulsed lasers), with dedicated tutorials and mentoring for technical experts.

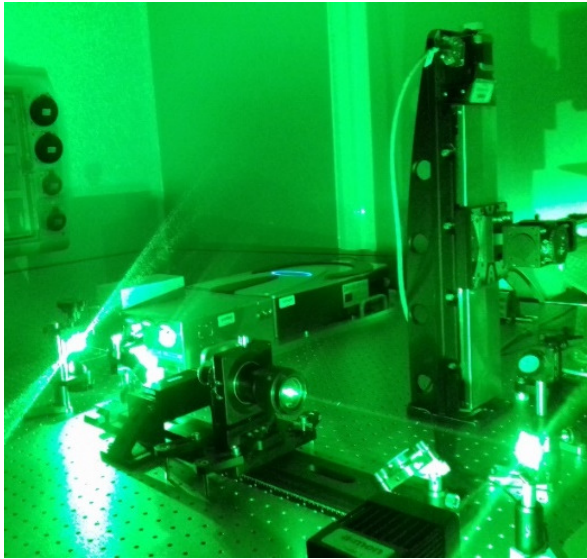
# Target Audience

It is desirable but not essential that course attendees have a basic understanding of laser processing of materials. The course is ideally suited to those planning to provide new properties to their products, establish in-house or outsource manufacturing by means of laser technologies.

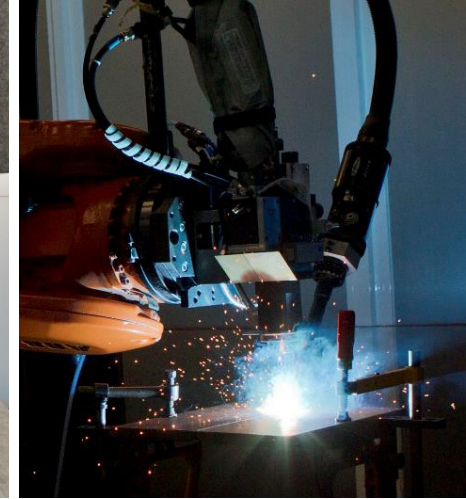
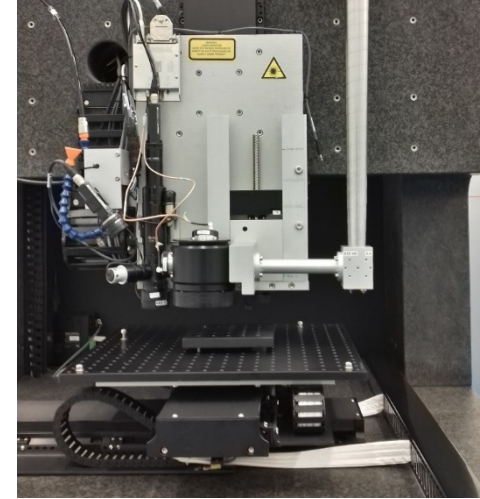
# Expected Outcomes

- 1) Understanding the key principles of laser welding of metals and surface patterning in different scenarios
- 2) Understanding the different laser beam properties and the available tools for analyzing the key characteristics (hands-on activities)
- 3) Select the different parameters for different laser-based manufacturing processes (hands-on activity)
- 4) See the fabrication processes in representative environment (hands-on activity)
- 5) Understand the quality aspects related to the process (hands-on activity)

# Course Equipment & Infrastructure



+20 laser sources available



+15 laser cells



Laboratory facilities for samples characterization

# Course Schedule

Day & Time	Training Activity
Day 1 (09:00 – 13:00)	Course Introduction & Laser material processing: welding & patterning (lectures)
Day 1 (15:00 – 17:00)	Laser beam characterization and diagnosis (hands-on)
Day 2 (09:00 – 11:00)	Laser welding parametrization (hands-on)
Day 2 (11:00 – 13:00)	Advanced laser welding (hands-on)
Day 2 (15:00 – 17:00)	Process monitoring in laser welding (hands-on)
Day 3 (09:00 – 11:00)	Surface functionalization with direct laser patterning technologies (hands-on)
Day 3 (11:00 – 13:00)	Ultrafast laser surface structuring and nanopatterning (hands-on)
Day 3 (15:00 – 17:00)	Surface characterization (hands-on)

# Course Details (Day 1)

Day 1a. Course Introduction; Laser material processing: welding & patterning (lectures)

Location: AIMEN – Laser Applications Centre – Lecture room

Details: Lectures on principles of laser material processing and focus especially on welding (types of processes, types of joints, key parameters) and on different surface patterning approaches with different practical examples. In addition, principles of laser beam analysis and functional characterization will be provided.

Training Duration: 4 Hours

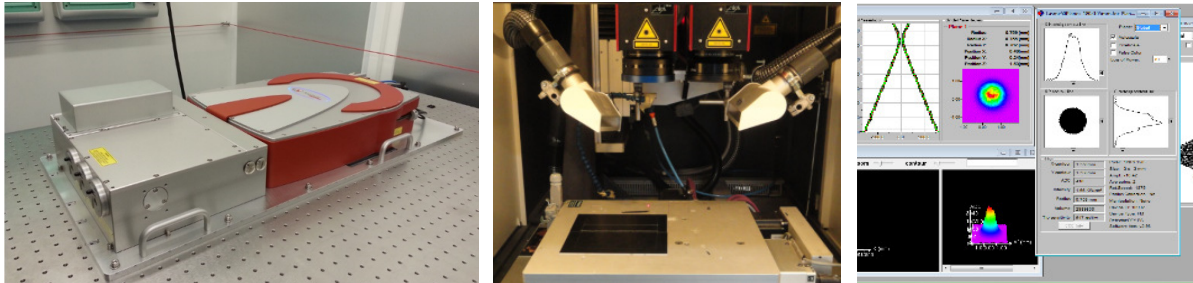


Day 1b. Laser beam characterization and diagnosis (hands-on)

Equipment Used: PRIMES laser beam characterization, SPIRICON LBS-300 and Mode Check; Power measurement sensors, Autocorrelator for ultrashort laser pulses characterization.

Details: Beam characterization and diagnosis of at least two different setups.

Training Duration: 2 Hours



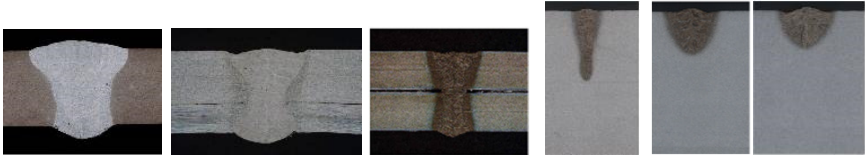
# Course Details (Day 2)

## Day 2a. Laser welding parametrization (hands-on)

Equipment Used: TRUMPF TRUDISK 16kW / COHERENT Fiber laser 8kW, ABB robot, laser processing head

Details: Influence of laser welding parameters in at least 2 different welding configurations: butt joints and overlap in steel and aluminium.

Training Duration: 2 Hours



## Day 2b. Advanced laser welding (hands-on)

Equipment Used: TRUMPF TRUDISK 16kW / COHERENT Fiber laser 8kW, ABB robot, laser processing head.

Details: Laser welding with scanner (remote) head and dissimilar welding.

Training Duration: 2 Hours

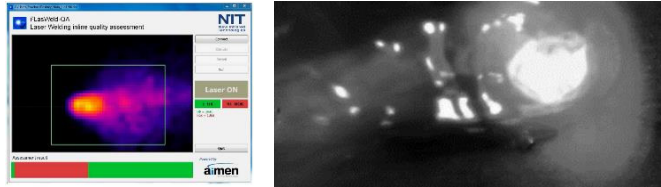


## Day 2c. Process monitoring in laser welding (hands-on)

Equipment Used: TRUMPF TRUDISK 16kW / COHERENT Fiber laser 8kW, ABB robot, laser processing head, high speed camera and different types of sensors.

Details: Use of different sensors during laser welding trials in order to assess process stability and influence on samples quality.

Training Duration: 2 Hours



# Course Details (Day 3)

Day 3a. Surface functionalization with direct laser patterning technologies (hands-on)

Equipment Used: ROFIN POWERLINE 20 (IR ns laser); ROFIN POWERLINE 20 SHG (SHG ns laser); TRUMPF TruMark 6350 (THG ns laser)

Details: Selection of right wavelength and processing parameters with different nanosecond laser sources. Analysis of the surface finishing and affectation with different scanning strategies on both metal and polymer materials.

Training Duration: 2 Hours

Day 3b. Ultrafast laser surface structuring and nanopatterning (hands-on)

Equipment Used: AMPLITUDE SATSUMA HP2

Details: Optical setup alignment, selection of process parameters and scanning strategy. Observation of the nonlinear effects, self-organized structures and LIPSS.

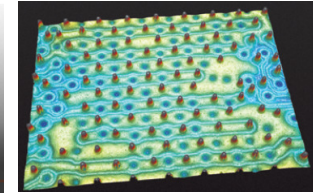
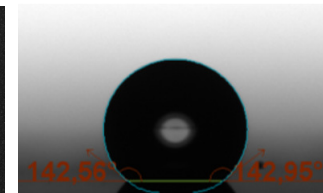
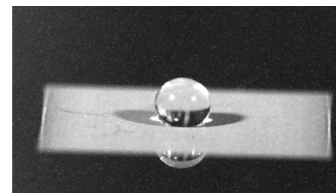
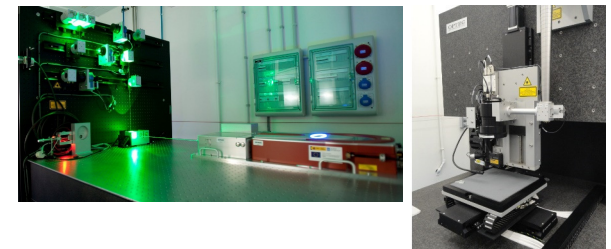
Duration: 2 Hours

Day 3c. Surface characterization (hands-on)

Equipment Used: optical microprofiler: Sensofar NEOX; Equipment for functional characterization: contact angle, tribometer, scratch test, etc.

Details: characterization of the functional surfaces by means of optical microscopy, optical microprofiler, analysis of surface energy and wettability, tribological characterization.

Training Duration: 2 Hours





# Course Trainers



**Course Director: Pablo Romero**

**Course Manager: Nerea Otero**

**Laser welding lecture, parametrization & advanced welding: Rosa Arias**

**Laser beam characterization and diagnosis: Félix Ares / Sara Vidal / Rosa Arias**

**Surface functionalization with direct laser patterning technologies: Félix Ares**

**Ultrafast laser surface structuring and nanopatterning: Sara Vidal**

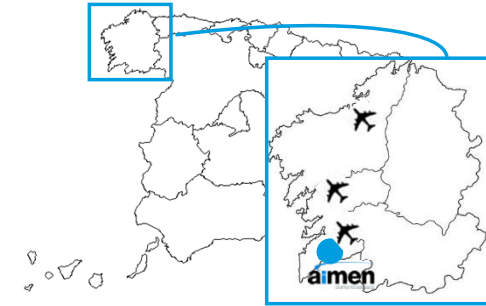
**Process monitoring in laser welding: Camilo Prieto**

**Surface Characterization: Tamara Delgado**

# Course Location, Schedule & Cost



AIMEN  
Technology  
Centre,  
Spain



- Course Schedule (March, June, November – exact dates to be confirmed)
- Number of people (Groups of 6 people per course)
- Course Cost (900€)

## Further Information

- [promero@aimen.es](mailto:promero@aimen.es)
- [www.aimen.es](http://www.aimen.es)
- [www.photonhub.eu/euphotonicsacademy](http://www.photonhub.eu/euphotonicsacademy)

# Keywords

Functional surfaces, laser surface patterning, nanosecond laser, femtosecond laser, picosecond laser, Laser direct writing, laser beam characterization, surface characterization, laser, surface wettability, confocal microscopy, surface topography, Metals, polymer, composites, tribology, Laser welding, Dissimilar joints, Laser arc hybrid welding, Process monitoring, Quality control, Automation, High speed imaging, Optics, Laser safety, Machine vision, Robotized Processes, metallurgy, metallography,