Project offers / Expressions of Interest from Jülich

Joint Research and Education Programme "Palestinian-German Science Bridge PGSB"
Forschungszentrum Jülich GmbH & Palestine Academy for Science and Technology

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Director	Central Institute of Engineering, Electronics and Analytics – Engineering and Technology (ZEA-1) http://www.fz-juelich.de/zea/zea-1/EN

University affiliation*

RWTH Aachen, Faculty for Mechanical Engineering

Initial contacts at Palestinian university/universities (if available)

Thesis candidate(s) (if available)

Project description*

Principle investigations about the laser beam welding process

The Central Institute of Engineering, Electronics and Analytics – Engineering and Technology (ZEA-1) is a scientific technical institute of the Forschungszentrum Jülich GmbH. Mission of ZEA-1 is the design, the development, and the fabrication of scientific and technical equipment, instruments, and processes that are essential for cutting edge science but are not commercially available.

The core competencies of ZEA-1 are technology development and mechanical engineering of equipment, spectrometers and other components for research using neutron, photon, and hadron beams, for energy and environment research, for soil and plant investigations and for the neuroscience. ZEA-1 has broad and longtime experiences in innovative manufacturing techniques, joining technologies, measurement technologies, automation, and calculation and numerical simulation methods.

In the framework of the "Palestinian-German Science Bridge" education program several fellowships for master- and/or PhD-thesis are offered:

Line-laser-scanner-application in the laser beam welding process

Laser beam welding is meanwhile a well-established process in the industry. But with the advent of new laser beam sources with higher power and excellent laser beam quality new problems came to light. One of the most serious problems is the coupling of the radiation into the material of the welded parts. The intensity of the laser radiation created by the new laser sources is extremely high therefore there are a lot of defects, imperfections and even burn-through. Such laser beam sources are perfect for cutting, but for welding a wider melting pool is needed to have a stable process. Thus

one has two possibilities: to defocus the laser beam, which leads to an undefined laser beam profile or to deflect the laser beam crosswise to the seam. For the second possibility a disc-laser with 4 kW power is equipped with a line-laser-scanner with deflection frequency up to 1 kHz and deflection range of 20 mm. Such a unit also offers the possibility to deliver different levels of laser power along the scan line. All these allow minimizing disturbing influences on the weld.

The advantages and limits of using a line-laser-scanner should be investigated in a master thesis. To achieve knowledge about the application possibilities with different materials processes in the welding pool and along the deflection line should be examined. For this purpose high-speed videography and infrared thermography should be used. To investigate the structure or density of the welds cross section and if necessary other metallographic analysis should be performed.

A master thesis about investigation of the line-laser-scanner-application by the laser beam welding process is offered.

Welding application of a laser with 515 nm wavelength with high reflexivity materials“

Laser beam welding is well-established in industry, but for welding some materials like copper using lasers with wavelengths in the near infrared (NIR) tremendous problems exist which restrict the use of this technology. One of the most serious problems is the coupling of the radiation into the material of the welded parts. The high reflexivity of copper at wavelengths in the NIR demands the use of high power laser beam sources but with the risk of back reflections and possible destruction of the laser beam optics. Further problem are the defects and imperfections in the seams welded with high laser beam power. One possibility to improve the level of coupling into the material is the use of laser beam sources with lower wavelengths. The absorption of copper increases from ~ 4 % at 1030 nm a wavelength, which is the standard wavelength of a disc-laser, to ~ 40 % at 515 nm wavelength.

To perform these investigations we are equipped with a frequency-converted-disc-laser, i.e. the frequency is doubled so the wavelength is the half of the original disc-laser wavelength. The converted laser light is green. The advantages and limits of using a green laser beam source should be investigated in a master thesis. To achieve knowledge about the application possibilities with different high-reflective materials first experiments should be performed and analyzed. To investigate the structure or density of the welds cross section and other metallographic analysis should be performed.

A master thesis about investigation of welding application with high reflexivity materials using a 515 nm wavelength laser is offered.

Date*	**Signature***
24.11.2016	Prof. Dr. G. Natour

* required field