Optical emission spectroscopy and imaging during synthesis of Nanoparticles, Laser Welding and Additive Manufacturing

Antaryami Mohanta, Briac Lanfant, and Marc Leparoux
Empa–Swiss Federal Laboratories for Materials Science and Technology,
Laboratory for Advanced Materials Processing, Feuerwerkerstrasse 39, 3602 Thun, Switzerland

Optical emission spectroscopy and imaging during synthesis of Nanoparticles

Induction plasma synthesis of Nanoparticles

Gas streams for graphene nano-flakes
- Sheath gas: Ar (10 slpm)
- Central gas: Ar (12 slpm)
- Sheath gas: Ar (60 slpm) + H2 (4 slpm)

Hybrid, gradient, composites materials

Laser Metal Deposition (LMD)

Powder supplied through a nozzle to a molten pool formed by laser irradiation
- Productivity (high speed)
- Complex geometries (5 axes)
- Large devices
- Powder feed - focus

Additive Manufacturing

High Speed Imaging applications for LMD

3D printing of Si pillars on monocrystalline Si wafer
- Fracture at the Si pillar basement
- Transport of several powders at the same time: Hybrid, gradient, composite materials - 3D printing of micrometric scale samples
- Fundamental investigation of Laser/material interactions
- PhD Dissertation:
  - M. Le Dantec: Advisor: Patrik Hoffmann
  - Topic: Additive Fabrication of Silicon Pillars on Monocrystalline Silicon by Direct Laser Melting

3D printing of Al alloy: AlMg5
- T1 Mg = 1090 K
- T1 Al = 2519 K
- Laser power = 200 W
- Pulse width = 1 ms
- AlMg5 (Pristine)
- AlMg1.7 (After 1 laser shot)
- Mg evaporation rate > Al evaporation rate
- Control of evaporation rate of material deposited and substrate (evaporation not desired)
- AlMg5 reinforced with n-particles

OES applications for LMD

Contact: marc.leparoux@empa.ch  antaryami.mohanta@empa.ch