Industry Drivers
- Key EU industries (automotive, aerospace, oil and gas...) require high performance coating processes to protect, add value, repair or extend the service life of components
- **Cold spray** is a promising solid state process using supersonic, powder particle spraying, giving high quality coatings with good properties
- 'Need for speed' when spraying harder particles can require use of gas heating and expensive helium
- Laser heating/softening of substrates can reduce speed and temperature requirements, and avoid helium use, but is currently a low TRL process

Developments
- Proprietary laser heating equipment developed
- Bespoke process monitoring and control equipment also built
- Both retro-fitted to existing cold spray guns
- Coatings deposited on to different pre-forms
- Coating qualities and properties analysed

Deposit properties
- Coatings nearly as hard, or harder, than substrate
- Corrosion barrier coatings possible (green arrow)
- Cohesion and adhesion
  - ~20-40 and ~160-190MPa (Al alloy)
  - ~20-30 and ~55-60MPa (bronze)

Conclusions
- Precise laser heating achieved with bespoke controls developed
- Heating confirmed to improve coating cohesion, and coating/substrate adhesion, of selected coatings
- Porosity contents reduced
- Adhesive and cohesive strengths higher
- Coating oxygen contents not raised by laser heating
- Coatings slightly softened by laser heating
- Higher heat inputs necessary for even harder substrates, e.g. Ni alloy/Ni alloy

Technical barriers
- Limited amount of published data on laser assisted cold spray routines
- No integrated system design exists for laser assisted cold spray system
- Omni-directional processing not readily possible
- Laser beam 'footprint' where powder impinges on surface cannot be controlled by the operator
- Limited opportunities for full process optimisation
  → Development of new coaxial equipment, controls and processing routines, to take full advantage of process

Deposit qualities
- Improvements in a range of cold spray coatings with laser heating
  - Cu bronzes on steel
  - Ni alloy on steel
  - Al alloy on aluminium
- Porosity contents
  - ~0.1-0.3% (with laser)
  - ≥0.5% (without laser)
- Oxygen contents
  - ~0.2% typical

Monitoring and Control
- Built-in thermal sensor gives stable process monitoring signal
- Signal filtered and used to control laser heating
- Temperature control to setpoint +/-20ºC appears possible

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