Modelling for LASER Cladding Process
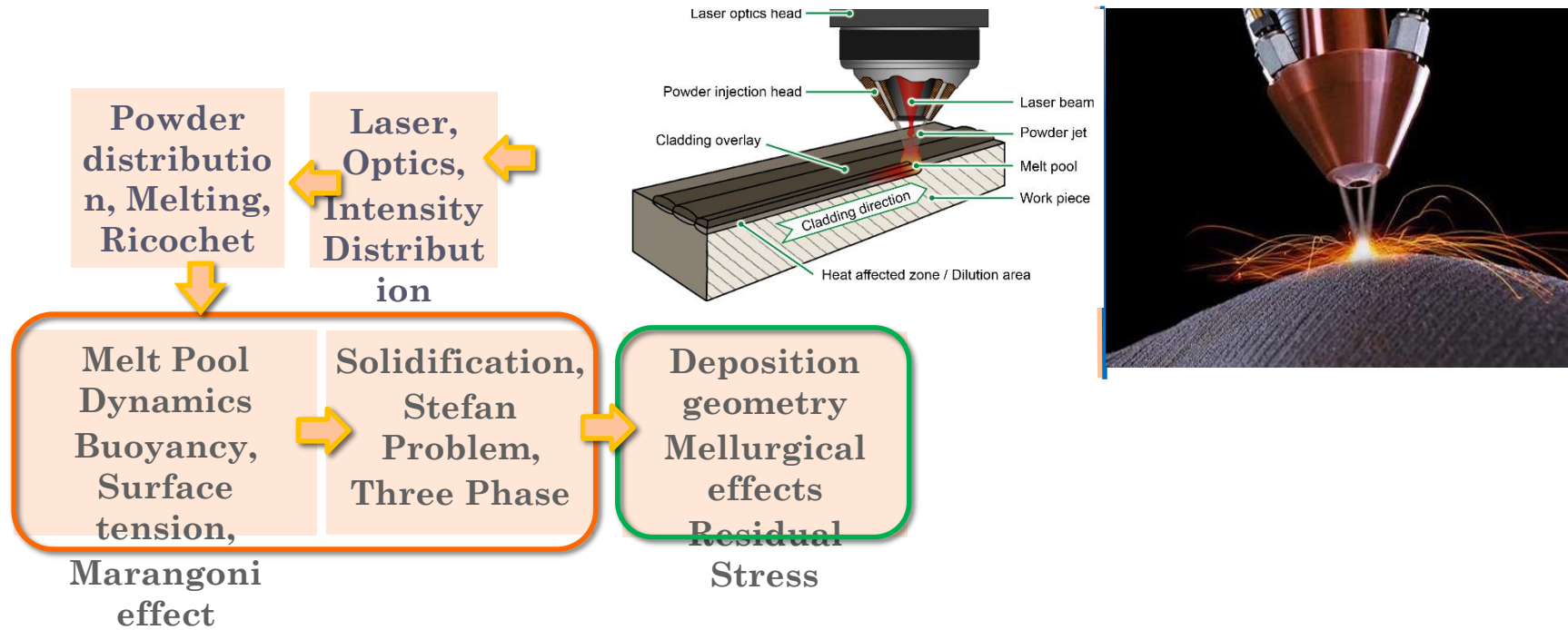
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MODELING OF LASER CLADDING

Powder distribution, Melting, Ricochet

Laser, Optics, Intensity Distribution

Melt Pool Dynamics Buoyancy, Surface tension, Marangoni effect

Solidification, Stefan Problem, Three Phase

Deposition geometry Mellurgical effects Residual Stress

Preliminary Objectives

- Develop a model to predict the temperature and stress distribution of the Laser cladding process
- Code various phenomenological equations to estimate some secondary variables:
  - Hardness
  - Phase Transformations and its effects
  - Grain size

Facilities are available in the machine tool laboratory if you want to conduct some preliminary experiments to validate your computational model

Laser cladding process

- Laser cladding is a coating technique, wherein several layers of clad materials are deposited over a substrate so as to enhance the physical properties of the work-piece such as wear resistance, corrosion resistance, etc.

- Strong interfacial bond with minimum dilution between the material layers is a pre-requisite of the process. This technique also finds widespread applications in repair and restoration of aerospace, naval, automobile components
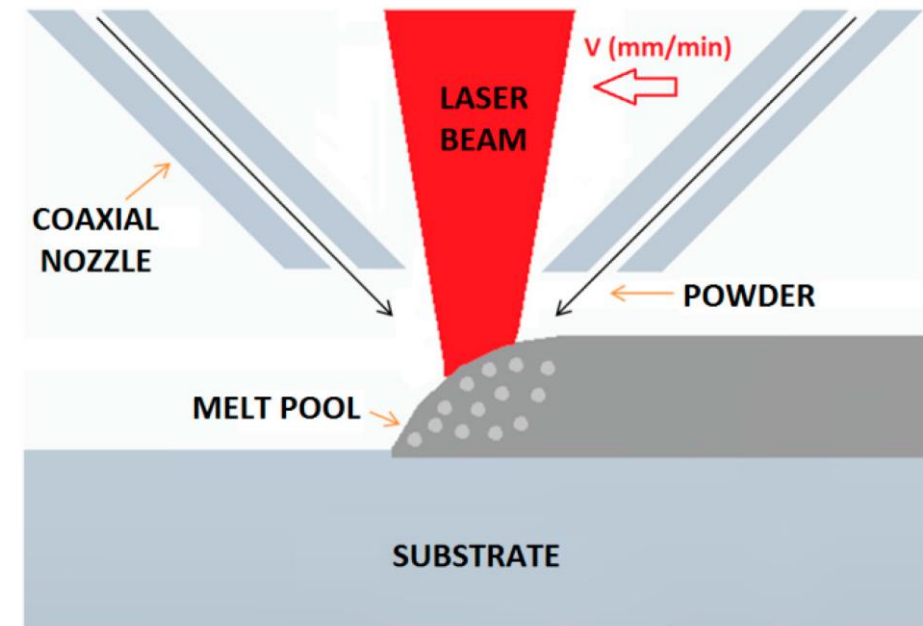
Temperature distribution

Because of higher power, rapid heating and cooling rate, small size molten pool, high temperature in laser cladding, it is very difficult to measure its internal temperature distribution and the cooling speed. At present, material temperature field distribution under the action of laser is obtained by means of numerical analysis and numerical simulation

Numerical simulation assumptions

To simplify calculation the follow assumptions is made:

• Materials are isotropic

• Neglecting the flow function of molten pool fluid

• Neglecting material vaporization

• Neglecting keyholes effects, latent heat of phase change and thermal deformation

References

- http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.861.3911&rep=rep1&type=pdf

- https://www.researchgate.net/publication/273886648_THERMO-MECHANICAL_MODELLING_OF_LASER_CLADDING_OF_CPM9V_ON_H13_TOOL_STEEL

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