University of technology
Laser and optoelectronics eng. Dept.

LASER APPLICATION COURSE
4^{TH} YEAR
LEC.9

ALLOYING

- This involves spreading metal powder over the surface then laser is passed so that surface melting occurs which allows for the metal powder to be alloyed with the base metal, so that modified surface characteristics are produced

Cladding

- ***1.Definition:***
- ***Laser cladding*** is a melting process in which the laser beam is used to fuse an alloy addition onto a substrate. The alloy may be introduced into the beam–material interaction zone in various ways, either during or prior to processing[7].
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- ***2. The goal***
- Laser cladding, provided wide range from cladding alloys for use. Because of the most substrates that tolerate laser melting are generally suitable for cladding: carbon – manganese and stainless steels, and alloys based on aluminum, titanium, magnesium, nickel and copper. Popular cladding alloys are based on cobalt, iron and nickel.

- ***3. Laser Source***
- - CO_2 lasers have traditionally been used for cladding because for many years they were the only sources that could provide the power density required for melting.
- - As multikilowatt Nd:YAG lasers with fibreoptic beam delivery became more widely available. Because:
- 1. The potential for lower cost.
- 2. Flexible coating of three-dimensional components was realized.
- 3. The improved absorption of the shorter wavelength Nd:YAG laser beam by metallic alloy additions provides a means of increasing the process efficiency and increasing coverage rates.
- - The absorptivity of powder additions to a multikilowatt diode laser beam is about twice that of a CO_2 laser beam, and the rectangular cross-section of the beam is an ideal shape for high coverage rates. The properties of clads produced by using diode lasers are similar to those produced by CO_2 and Nd:YAG lasers.

- ***4. Power***
- For practical laser beam cladding a power density of about 100Wmm^{-2} and a beam interaction time of about 1 second are used. About 2kW is the normal minimum laser beam power needed for cladding, since insufficient power will result in limited melting of the alloy addition, whereas too much power causes excessive melting of the substrate and dilution of the clad.
- ***5. Advantages***
- High quality (The molten clad solidifies rapidly, forming a strong metallurgical bond with the substrate).
- High speed,
- Easily automated.

ANNEALING

- One of the main areas of semiconductor processing is the annealing of ion implant damage. Annealing (Re-crystallization) may be made by heating to about 1000^{o}C for 30 minute. Laser annealing is quite fast than the classical methods (heating in a furnace).

MICROMACHING

- There are several areas in which the ability of laser to selectively vaporize small areas of material is useful. One such example is in the laser trimming of resistors. Resistors are made by a wide variety of techniques but often consist of a thin film of conductive material deposited on an insulating substrate between two electrodes Figure (2.4-a). As manufactured the films may not have exactly the required resistance and so require some kind of trimming. Whit a laser this may be achieved in several ways. For example, the resistance may be increased by selectively removing material from the film either by drilling holes or by cutting slots in the film figure (2.4-b-c).

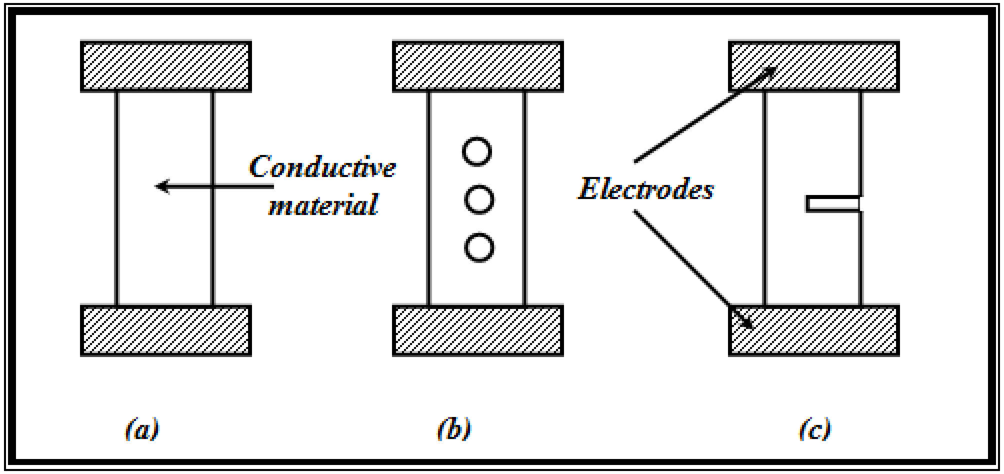

Figure (2.4) Use of laser for resistor trimming: (a) shows the basic resistor structure; (b) the resistance is increased by drilling holes in the conductive material; (c) a slot is cut[4]

- ***Laser marking***
- Is a process whereby serial numbers or other identification include logos, is placed on parts by evaporating a small amount of material with a pulsed CO_2 or Nd-YAG laser[2].
- High speed,
- Easily automated.
- No mechanical contact with the workpiece.