UNIT-4- POWDER BASED ADDITIVE MANUFACTURING SYSTEMS

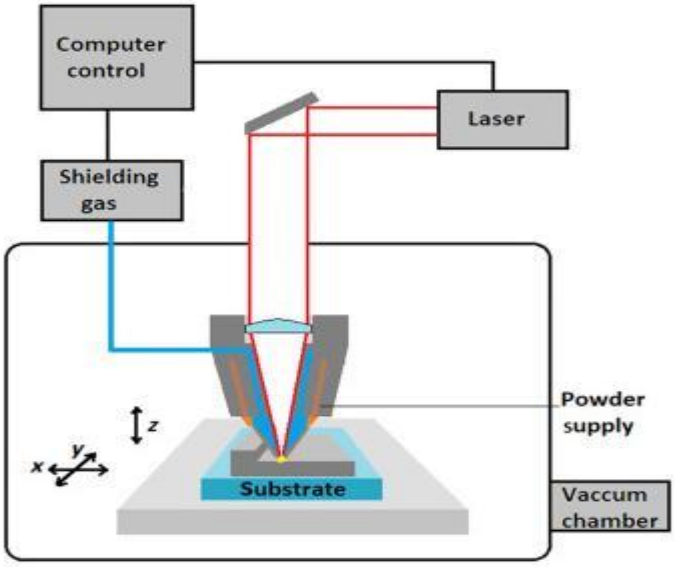
Laser Engineered Net Shaping (LENS)

What is laser engineered net shaping LENS?

Laser Engineered Net Shaping (LENS) is **an additive manufacturing process created in 1995 that allows building high-density metals and ceramics parts with no need for further operation**.

Laser-engineered net shaping (LENS) technology was jointly conceptualized by Sandia National Laboratories and Pratt. A schematic of this process is shown in Figure. Unlike in SLM, which has a powder bed, the component is manufactured using the LENS technique by supplying a powder through nozzle injection and irradiating a laser beam with high energy density to melt and deposit over a build base-plate in a layer-by-layer scheme. After deposition of each layer the build platform moves down in a controlled manner. This process repeats until an expected component is realized. Although the LENS technique was basically developed to produce complex geometrical components, it also has an ideal for repair and refurbishment of damaged components and structures. It should be noted that, the LENS has few concerns such as need for post processing, poor component surface finish, and distortion in the components due to residual stresses.

LENS is an extension of laser cladding process in which multiple layers are deposited to form a predefined object. Powders are blown through nozzle into a melt pool created by laser beam on the substrate to make a deposited line. Several lines are deposited adjacent to each other to make a layer. The layer-making process is repeated till an object forms. The process has used many materials such as tool steel, steel, titanium-based alloy, nickel-based alloy, aluminum, and various ceramics



Laser, powder, and laser–powder interaction are common in both LENS and SLS/SLM. The major difference is that the former is blown-powder technique while the latter is powder bed technique. LENS generally uses higher laser power (in terms of kilowatt) and larger spot size, which make its deposition rate higher.

The process unlike SLS does not use plastics. This is because plastics do not flow well through the nozzle. This restricts its use in various applications where plastics are a necessity. The products formed are generally metallic and some consist of ceramics.

The process gives an advantage to vary the composition of powder by using more than one powder feeder. This can help make a product of compositions different at its different places or develop FGMs (*121*,*163*). Mixing of various ratios of powder at the melt pool gives possibility to study and research new metallurgical phenomena. These are not possible through SLS/SLM. LENS allows repair, modification, and addition of values to existing products of various geometries by using the same material (of the product) or better material.

Laser Engineered Net Shaping

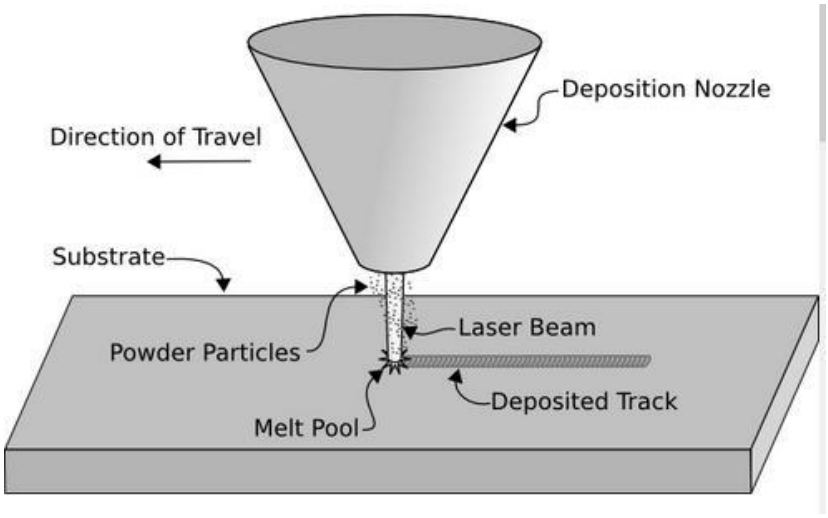
LENS was developed in Sandia National Laboratories, USA, to fabricate metal components directly from CAD solid models and reduce the lead times for metal part fabrication (61). The system consists of an Nd:YAG laser, a controlled atmosphere glove box, a three-axis computer-controlled positioning system, and a powder feed unit. The positioning stages are mounted inside a controlled atmosphere glove box, backfilled with argon, operating at a nominal oxygen level of 2–3 parts per million. The beam is brought into the glove box through a window mounted on the top of the glove box and directed to the deposition region using a Plano-convex lens. The powder delivery nozzle is designed to inject the powder stream directly into the focused laser beam, and the lens and powder nozzle move as an integral unit. Tool path patterns to build each layer are obtained by electronically slicing the previously built CAD solid model into a sequence of layers. Physically each layer is fabricated by first generating an outline of the key component features and then filling the cross-section using a raftering technique. The desired component is built one layer at a time, starting from the bottom of the part. A solid substrate is used as a base for building the LENS object. The laser beam is focused onto the substrate to create a weld pool in which powder particles are simultaneously injected to build up each layer.

Is laser engineer net shaping a process?

Laser Engineered Net Shaping, or LENS, is **a process in which near-net-shape metal structures are built of powdered metal layer by layer from computer-generated designs**.

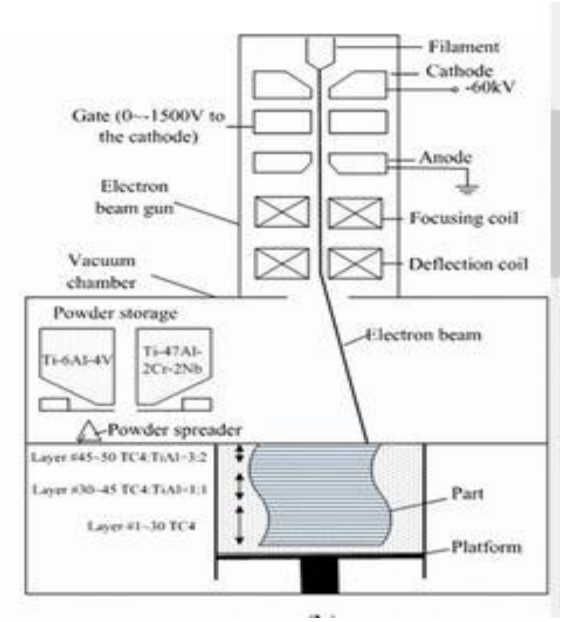
What is the LENS technique in additive manufacturing?

Laser Engineered Net Shaping (LENS) is an Additive Manufacturing (AM) technology where **powdered material is fed into a laser-induced melt pool and solidified in layers**.



What is the principle of the LENS process?

Basic principles of a Laser Engineered Net Shaping (LENS) and b Electron Beam Selective Melting (EBSM). In the LENS process **a continuous stream of powder is delivered to the focal point of a laser, at the melt pool; in EBSM a bed of powder is spread before being selectively melted**.



What are the types of processes in lens making?

Surface Finishing: After the lens has been cut to shape, it is subjected to a series of surface finishing processes to improve its surface quality and to ensure that the lens is optically correct. This may include processes such as polishing, coating, and surface modification.

How does laser engineer work?

A laser engineer is one who **specializes in making and developing laser devices or machines that is for laser purposes**. They supervises the laser team in operating and ensuring that all laser-related equipment is functioning well. They can also specialize in doing advanced optics or optic devices.

About Additive Manufacturing

- VAT Photo polymerization. Vat polymerization uses a vat of liquid photopolymer resin, out of which the model is constructed layer by layer.
- Material Jetting.
- Binder Jetting.
- Material Extrusion.
- Powder Bed Fusion.
- Sheet Lamination..
- Directed Energy Deposition.

What are the different types of lasers used in additive manufacturing?

3D printing lasers are used for selective laser sintering (SLS) and selective laser melting (SLM) in the powder bed fusion method. Existing commercial additive manufacturing systems use several laser technologies, with powers between one W to six kW and wavelengths between ultraviolet/354.7 nm and infrared/10.6 μm.

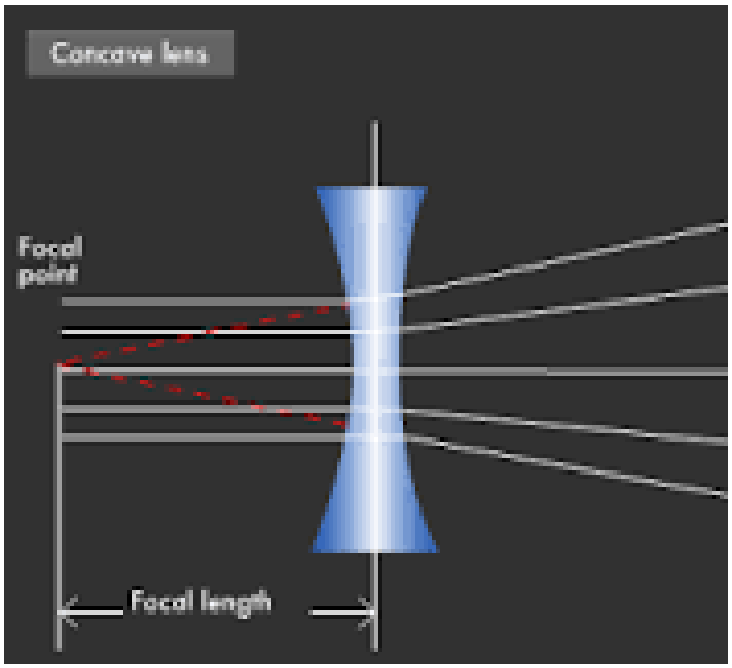
What is principal point of lenses?

The principal point is **the point on the image plane onto which the perspective center is projected**. It is also the point from which the focal length of the lens is measured. Near the principal point is the principal point of auto collimation (PPA).

What is lens magnification principle?

In principle, **a real image A formed by an objective lens is magnified by an eyepiece lens and viewed as a virtual image B**. As a result, the magnified objects can be observed as if they were just in front of your eyes.

What are the 2 main types of lenses?



Lenses may be divided broadly into two main types: **convex and concave**. Lenses that are thicker at their centers than at their edges are convex, while those that are thicker around their edges are concave. A light beam passing through a convex lens is focused by the lens on a point on the other side of the lens.