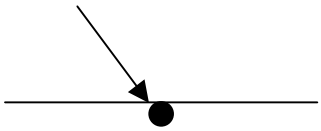
SOUTHWEST INNOVATIVE SOLUTIONS, INC.

Medical Laser Glossary

Ablation: Tissue removal by means of vaporization; debulking

Absorption: One of the four interactions of laser light with biological tissue. Matter interaction with radiant energy resulting in an energy Transformation (ie. Laser energy transformation to thermal energy when contact is made with tissue thus absorption of that thermal energy by tissue) highly concentrated effect on the tissue



Active media: Material in an optical cavity consisting of the atoms or molecules to be stimulated to an active or "excited" energy level; thus becoming lasing media.

Amplification: Process of increasing power, voltage or current in a signal

ANSI: American National Standards Institute; Federal documentation specific for Medical Laser Safety Standards; Specific documentation is ANSI Z136.3 to be used in conjunction with ANSI Z136.1.

Articulated arm: Configuration of mirrors in which relative motion is allowed to occur between parts, usually by means of hinged or sliding joints, capable of delivery laser beam output with minimal losses. (Currently used for CO2 lasers, Eximer lasers, some Q-switched pulsed systems)

Atom: Basis of all matter, consisting of nucleus which is positively charged, and orbiting electrons which are negatively charged.

Beam: Concentrated, unidirectional flow of light particles or a like propagation of electro-magnetic waves.

Boule: The solid crystalline matrix from which solid rod lasers are made.

Carbon Dioxide Laser: Common multi-specialty surgical laser. Active media of CO2 molecules as well as helium and nitrogen; lases in the far infrared of the electro-magnetic spectrum at 10600 microns (_m). Invisible to the naked eye.

Coherent Radiation: Radiant electro-magnetic energy consisting of the same characteristic wavelength and each wave traveling in-phase with one another. For radiation to be considered coherent, it must be in-phase both in time and space, unidirectional, monochromatic, and of one frequency. (one of the unique characteristics of Laser Light)

Collimation: All waves parallel to one another.

Electro-magnetic radiation: Any radiant energy containing both electro and magnetic fields.

Divergence: Increase in beam diameter with distance from the exit aperture of the laser to focal point.

Electro-magnetic: Chart of wavelengths and frequencies denoting energies given off by atomic systems.

Electron: Negatively charged particle which orbits the nucleus of an atom.

Emission: Any radiation of energy of electro-magnetic wave; laser output.

Energy: Power x Time: Watt-Seconds: equals Joules
1 mJ (millijoule) = 0.001 joule

Excited State: That state in which an atom, or molecule may temporarily achieve after certain input stimulation. This state is achieved by outer electron being stimulated to occupy higher atomic orbit.

Exposure time: Period of time a target area or tissue is exposed to laser energy.

Fiber Optic: Light guide; flexible glass bundle or single glass rod capable of carrying light energy.

Frequency: Number of complete cycles from a wavefront completed in 1 second. Frequency=1/wavelength (Hz)

Ground State: Normal resting state for an atom or molecule

HeNe Laser: Laser containing an active media of Helium and Neon gas. Lases in the visible spectrum at a variety of possible wavelengths or colors. Often used as an aiming beam for infrared, ultra-violet, or visible

pulsed lasers. Lases in the visible part of the electro-magnetic spectrum.

Hertz: The unit which expresses the frequency of a periodic oscillation in cycles per second

Infrared: Longer than visible area of electro-magnetic spectrum. Invisible, Non-ionizing

Irradiance: Energy Density or Fluence

Joules: Units for measuring energy. (watts-seconds)

KTP-532 Laser: Laser containing an active media of Neodymium doped Yttrium Aluminum Garnet with a frequency doubling (or _ wavelength) device (Potassium –K, Titanyl-T, Phosphate-P), that is placed in the Nd:YAG beam path, producing a 532 nm wavelength output.

LASER: Acronym; Light Amplification for Stimulated Emission of Radiation

Laser medium: Any selected substance capable of giving rise to a laser light source when excited.

Laser Pumping: Process which activates a lasing medium by absorption of energy.

Laser Safety Officer: A person appointed by the administration to administer a laser safety program. The person is responsible for effecting the knowledgeable evaluation of laser hazards, and is authorized and responsible for monitoring and overseeing the control of such laser hazards. (LSO)

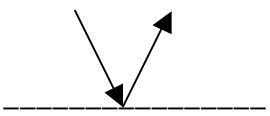
Light: Radiant Energy

Maximal Permissible Exposure: The level of laser radiation to which a person may be exposed without hazardous effects or adverse biological changes in the eye or skin. The criteria for MPE for the eye and skin are detailed in ANSI Z136.1, Section 8. (MPE)

MASER: Acronym; Microwave Amplification by the Stimulated Emission of Radiation, Precursor device to LASER

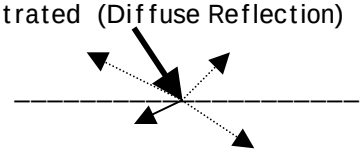
Micron:	Measurement of 10^{-6} meters, μ
Micromanipulator:	(mirrored joystick device) Device that controls the direction of a surgical laser beam precisely by the operator of a surgical operating microscope
Mode:	1. The geometric pattern of laser radiation output 2. Choice of exposure to target tissue (continuous, single, repeat, mode locked, q-switched)
Molecule:	Two or more atoms in a bonded existence (smallest particle of a substance that exists in a stable and independent state)
Monochromatic:	Existence of any one (or a small band) color(s) or wavelength(s); a characteristic of laser light
Nanometer:	Measurement of 10^{-9} meters, nm.
Nd:YAG Laser:	common surgical laser. Solid rod type laser, active media consists of the lasing element neodymium doped into a rod matrix of Yttrium Aluminum Garnet. Lases in the near infrared range of electro-magnetic spectrum at 1064 nm. Invisible to the human eye.
Neutron:	Neutrally charged particle found in the nucleus of an atom.
Nominal Hazard Zone:	The space within which the level of the direct, reflected, or scattered radiation during normal operation exceeds the applicable MPE. Exposure levels beyond the boundary of the NHZ are below the appropriate MPE level. (NHZ)
Optical Density:	Logarithm to the base of ten of the reciprocal of the transmittance (calculation of how much of a specific wavelength of energy is absorbed or filtered)
Optical Resonator:	Laser cavity: consists of laser active media as well as reflective mirrors aligned at either end of the cavity.
Photocoagulation:	Use of laser beam to heat tissue below vaporization with objective to stop bleeding and coagulate tissue.
Photon:	Particle of light.

Plume:	Smoke of particulate gaseous material produced by tissue vaporization of laser. (Biological Hazard, also called LGAC or Laser Generated Airborne Contaminate)
Population Inversion:	State in which more atoms, ions, or molecules exist in the excited state than in the ground or normal state when dealing with laser active media. Population inversion must exist before the lasing process can occur.
Power:	Basic measurement of laser output for continuous wave laser. Amplitude of wavefront. Not time increment involved. Power directly affects power density. (Measured in units of watts, w)
Power Density:	Power delivered to specific tissue or target area. (watt/cm^2)
Proton:	Positively charged particle found in nucleus of atom.
Pulse:	Laser output consisting of interrupted beam. Repetitive train of beam output pulses, or a single burst output.
Pulsed Laser:	A laser that delivers its energy in a single or train of pulses, pulsed due to specific lasing transitions.
Q-Switched:	High energy density electro-optical device used to adapt to laser devices for a variety of applications. Results in ultra-short pulse outputs, combined with very small spot sizes = extremely high energy densities.
Quanta:	Light packets of photons
Quantum leap:	Leap taken by an electron when a transition or orbital leap occurs. (change in energy level)
Reflection:	One of the four interactions of laser light with biological tissue. Reflective angle of light dependent of incident angle to target area. Reflected laser light has virtually no effect on the reflective target rather is reflected off of the surface.

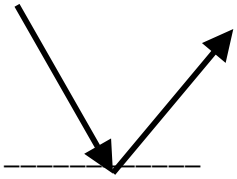


Refraction: Bending of light that occurs as light travels from one media density to another.

Scatter: One of the four interactions of laser light with biological tissue. Tissue effect dependent on absorptive qualities of the tissue. Tissue effects are diffuse and weakened: effects not well concentrated (Diffuse Reflection)



Specular Reflection: Mirror like reflection, Shiny surfaces



Spontaneous emission: Natural act of an excited atom, ion, or molecule to release energy in some form (photons) when the excited state is depleted and a drop to the normal resting state occurs.

STAR or RATS: Acronym denoting four possible actions of laser energy on target tissue; Scatter Transmission, Absorption, and Reflection

Stimulated Emission: Release of electromagnetic energy when an electron inverts energy from a higher state to a laser energy state in which the activity has been increased by an external source.

Spot size: Diameter of the laser beam at the tissue surface. Spot size has a reciprocal relationship to power density. (as spot size increases; power density decreases by a factor of x4)

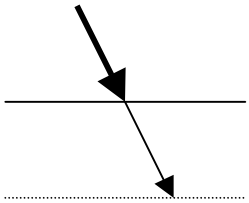
TEM: Transverse Electro-magnetic Mode; lasing mode of laser cavity; beam profile; (preferred TEM mode of surgical lasers TEM 00)

Thermal effect: Laser response to heat

Thermal Relaxation Time: Time it takes for target to cool 50% of initial temperature rise in tissue, depends on thermal properties and size of target (TCT is Thermal Containment Time, often considered optimal pulse time for specific target)

Transition: Travel of atom, ion, or molecule from one energy state to another, sometimes resulting in the release of a photon

Transmission: One of the four interactions of laser light with biological tissue, beam is transmitted or passes through the tissue having none, or very minimal effect on the tissue, looking for a target that is more specific to the absorption needs of the laser light energy.



Tunable laser: A laser system that can be tuned to emit laser light over a continuous range of wavelengths or frequencies.

Ultra violet radiation: Portion of the electro-magnetic spectrum: shorter than visible; ionizing. Invisible to the human eye.

Unidirectional or collimated: Collimated, all waves propagating or traveling in the same direction. (one of the characteristics of laser light)

Velocity: Speed and direction

Watts: Units for measuring power

Waveguide: Device used for a contained propagation of laser energy. (ie fiber optic), Each waveguide is specific for each wavelength

Wavelength: A specific characteristic of all radiant light of laser light. Length measurement of one complete cycle of a wave. (ie. From crest to adjacent crest) Wavelength = 1/frequency. Determines "type of laser or color emitted.