

Overview of Ceramic Components use in CO₂ Lasers

Aluminum Oxide “Alumina”, Al_2O_3 , is an inorganic, nonmetallic solid – a powder. It’s a crystalline material that when heated, pressed, and cooled can form a solid and have utility – a Ceramic. Alumina is an extremely hard material, often used in abrasives, and cutting tools, and it retains its mechanical properties at very high temperatures. Alumina is an electrical insulator, but unlike most electrical insulators, it has a very good thermal conductivity. Alumina has a relatively low coefficient of thermal expansion (CTE); approximately 1/3 of Aluminum. Alumina, by nature, is fully oxidized and non-reactive unless in the presence of strong acids or bases. Depending on the implementation, some, or all of these properties make Alumina a great choice for laser tube components.

It’s common for CO₂ Laser Manufactures to use ceramic components inside their laser tubes. Typical uses are for mounting required components, for example electrodes, and even for guiding the lasers beam-plasma. These implementations are very functional, however flawed due to the Ceramic components being in direct in contact with a reactive material, i.e., Aluminum. The differences in CTE cause the Aluminum and Ceramic to rub “scrub” against each other, continuously exposing fresh aluminum to the gas mixture. The Laser’s gas mixture is highly reactive, and when exposed to the fresh aluminum, they will react, changing the gas mixture, and hence the Laser’s characteristics.

Iradion’s technology turns the Laser “inside-out”. Ceramic is not used as a component inside the Laser Tube – It is the Laser Tube! Not only does it act as the Laser’s gas vessel, but also the superstructure for mounting other required components, and is part of the Laser’s electrical circuit. Further, all of the Laser’s required components, i.e., electrodes, are mounted outside, external to the Laser’s gas vessel where the plasma is generated, leaving only Alumina in direct contact with the Laser’s gas plasma.

This innovative concept yields a laser that has superior lifetime, reliability, and stability when compared with Lasers that use Ceramic as a component mounted inside of the Laser’s gas vessel.