# CO2 TEA Impact Laser Processing

At the opposite end of the spectrum to UV Excimer lasers one finds CO2 lasers, including TEA models (Transversely Excited Atmospheric), which are **close cousins of excimers** since their fundamental operating principle is the same, a box of gas, a pair of long electrodes between which an electrical discharge is initiated, and HR & OC optics. Like excimers, they are characterized by a large area multimode beam with short pulse duration & limited coherence and also are most commonly used with a mask projection technique.

Most CO2 lasers emit at 10,6µm. However other transitions are possible & a particularly interesting group of lasers are **pulsed CO2 TEA** lasers operating in the **9µm band** where there is a **stronger interaction with most polymers**. www.lightmachinery.com offer a range of such **Impact lasers**, which in some situations offer an extremely **cost-effective alternative** to excimer lasers, with faster throughput, simpler operation and significantly lower COO (cost-of-ownership). A key member of the Optec team was heard to say (before he joined Optec, 25 years ago), 'if you've ever used an Impact laser you won't want to look at an excimer again!' It is not, however, quite so simple, & more a question of horses for courses.


Impact interaction with polymers is more akin to rapid melting & vaporization than the photo-ablative decomposition with excimers. In a typical 'technical polymer' like PI or parylene:-

- Impact removes on the order of tens of µm per shot compared to the sub-µm of excimers, so for e.g. can strip insulation from wires at a **much higher rate, but essentially no depth control.**

- **Lateral resolution** of the projection optics is on the order of **30-40µm**, rather than µm level of excimers, essentially because of the wavelength limitation on optical resolution;- also limited by the interaction as above.

- Excimers can have trouble with fluoro/chloro-carbon polymers like PTFE (Teflon) and PDMS (silicone rubbers); with the limitations above, Impact has no such limitations.

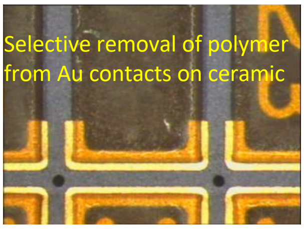
- Since metals are highly reflective in the IR, **selectivity polymer/metal is superior to excimer**, - but….

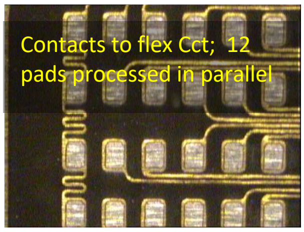
- A **key limitation** is that Impact **cannot remove the last 1-2µm** of polymer from a metal surface; at much below the wavelength, the light cannot quite 'get hold' of the polymer. A more erudite friend suggests that at a highly reflective surface the transverse E and B fields are close to zero, so the Poynting vector, E X B in a region a fraction of a wavelength from the interface is also close to 0, meaning energy transfer also zero. Same thing!

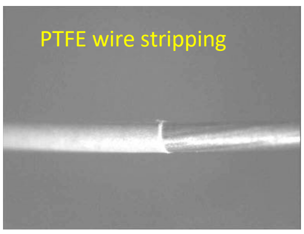
  For subsequent mechanical operation like crimping there is usually no problem, but soldering can require an additional treatment process step; chemical attack, plasma etch or final clean-up with small excimer have all been used successfully.

- Optics, usually ZnSe for refractive ones, multilayer on Si for mirrors, are significantly more 'robust' than for excimer. This is a question of wavelength, an optics which looks fine to us in the visible can have minute defects or invisible surface deposits that radically affect performance below 250nm; in the same way an optic which looks disgusting to us might still perform quite well at wavelengths 20X longer.

## Applications





## Machines

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