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Ultrashort Pulse Laser Cutting of NiTi in Liquid Environment

Laser treatment of medical stents is often regarded critically due to the introduction of heat into the material. Despite being termed “cold ablation,” ultrashort pulse laser processing still results in a non-negligible heat-affected zone, which demands subsequent processing steps. This is particularly relevant when processing fragile components such as wires or foils, where the heat cannot be dissipated across large volumes.

In this contribution, we demonstrate that laser ablation in liquids can significantly reduce the heat-affected zone and significantly improve the cutting quality. The superelastic NiTi foils are placed in a processing chamber in which a liquid medium is continuously flowing parallel to the specimens surface. This flow serves two purposes: it facilitates heat dissipation and binds the debris produced during ablation in the liquid, thereby preventing redeposition resulting in a cleaner surface both within and around the cut. The laser operating at 1030 nm is focused through a window and the underlying liquid onto the sample. A comparison with samples processed under an argon atmosphere reveals a significantly cleaner cut using laser ablation in liquids.

Process optimization involved systematic variation of laser parameters, and pulse burst configurations to maximize processing efficiency and variation of liquid media. Besides water, oxygen-free paraffin oil has been tested to minimize surface oxidation. Scanning electron microscopy images reveal different cutting kerf topographies depending on the fluid and laser parameters. Moreover, energy-dispersive X-ray spectroscopy gives insight into the extension of oxidation.

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