

Femtosecond Green Laser Micromachining of Challenging Materials for Target Fabrication

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Precision target fabrication often requires cutting and localized material removal in metallic systems that are difficult to machine by conventional means. Mechanical methods can introduce burrs, edge damage, and geometric constraints, while longer-pulse laser processes may produce significant redeposition and undesirable thermal effects. Femtosecond laser processing offers a non-contact alternative capable of high spatial precision with reduced heat-affected damage.

This poster presents recent work using a femtosecond green laser for cutting and ablation of target-relevant metallic materials. The study focuses on manufacturing outcomes critical to component quality, including feature fidelity, kerf geometry, edge condition, debris generation, and evidence of thermally affected material. Comparative observations across multiple material systems are used to distinguish common process behaviors from material-specific responses in ablation morphology and defect formation. Optical microscopy, electron microscopy, and dimensional inspection are used to evaluate processed features and identify dominant quality limitations.

Results indicate that femtosecond green-laser processing can produce high-quality features in challenging materials while reducing thermal artifacts relative to conventional high-energy removal approaches. Key remaining challenges include controlling redeposition, balancing throughput with feature quality, and tuning parameters to accommodate material-dependent behavior. This work supports the development of robust ultrafast laser workflows for precision target fabrication where cleanliness, repeatability, and dimensional fidelity are essential.

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