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Pump-probe experiments of single-pulse femtosecond laser plasma-channel formation in fused silica TREVOR S. BOWMAN, LLOYD M. DAVIS, University of Tennessee Space Institute — Femtosecond laser pulses provide a means to machine structures with small heat-affected areas with a highly non-linear mechanism that enables direct writing of nanoscale features. Fabrication at this scale can be applied to a large range of applications, including micro-optical and micro-fluidic devices. During single-shot ablation, the formation of opaque plasma in the focal region of a tightly focused beam typically limits the depth of the feature and creates a shallow crater. However, recent reports have shown the ablation of deep nanoholes with aspect ratios greater than 20. Proposed mechanisms for creating such high aspect ratio structures include nonlinear Kerr self-focusing and the reshaping of the Gaussian pulse into a Bessel profile. These mechanisms would create an elongated plasma channel beyond the focal region. We are developing a single-shot, pump-probe experiment to study the time-resolved formation and relaxation of plasma in femtosecond laser machining of fused silica. During the fabrication of high aspect ratio holes, the transmission characteristics of a frequency-doubled probe pulse with a controlled delay provide information about the plasma dynamics. We also briefly discuss time-resolved imaging of the material ejected during the ablation process.

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