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Laser-induced damage of fused silica at 355 and 1064 nm initiated at aluminum contamination particles on the surface*

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Aluminum was sputter-deposited through a mask onto fused silica windows to generate contamination particles of controlled size and shape on the surface. The particles were 1 μm circular dots, 10 to 400 μm in diameter. Aluminum shavings were also deposited on the windows to investigate the effects of particle-substrate adhesion. The silica windows were then illuminated repetitively using a 3-ns, 355 nm and a 10-ns, 1064 nm laser. The tests were conducted at normal incidence with particles on the front and the back side of the window. The first shot produced a plasma at the metal particle.

For front side contamination, minor damage occurred where the particle was located; such damage ceased to grow with the removal of contaminant material. More serious damage (pits and cracks) were occasionally initiated on the back side and grew to massive proportions after only a few shots. Back side contaminants were ejected on the initial shot, leaving a wave pattern on the surface but no further damage occurred with subsequent shots.

The damaged area where the particle was located scaled linearly with the size of the particle. However, the onset of massive damage on the back side seemed to occur when particles exceeded a critical size. Finally, the damage threshold of the window was found to be lower at 3 ω than 1 ω.

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