Laser ignition of combustible mixtures draw renewed interest due to the feasibility of practically applicable solid state laser systems and the development of new combustion processes in IC engines like homogeneous charge compression ignition (HCCI). The features of the laser ignition process and the development of combustion in high pressure environments like gas cells and optical accessible engines were studied by a combination of optical and laser diagnostic tools. Spectrally and temporally resolved emission and Schlieren imaging were employed to study the initial stages of optical breakdown, plasma development and shock wave generation. Fluorescence imaging, chemiluminescence and transient grating evolution were used to observe the onset of combustion, the development of the flame kernel and the ignition limits in lean mixtures. The feasibility of laser ignition for HCCI combustion in an optical accessible engine was investigated.

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