

ABSTRACT

METHOD AND APPARATUS FOR PERFORMING LASER FILAMENTATION WITHIN TRANSPARENT MATERIALS

Systems and methods are described for forming continuous laser filaments in transparent materials. A burst of ultrafast laser pulses is focused such that a beam waist is formed external to the material being processed without forming an external plasma channel, while a sufficient energy density is formed within an extended region within the material to support the formation of a continuous filament, without causing optical breakdown within the material. Filaments formed according to this method may exhibit lengths exceeding 10 mm. In some embodiments, an aberrated optical focusing element is employed to produce an external beam waist while producing distributed focusing of the incident beam within the material. Various systems are described that facilitate the formation of filament arrays within transparent substrates for cleaving/singulation and/or marking. Optical monitoring of the filaments may be employed to provide feedback to facilitate active control of the process.

Fig. 1(e)