Generation of shape-invariant flat-top laser beams

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ABSTRACT
A great number of laser applications need in place of the usual Gaussian beam a flat-top intensity profile in the focal plane of a focusing lens. In general the transformation of the laser beam from the Gaussian to the flat-top shape is made by a diffractive beam shaping technique. It is worthwhile to note that this transformation occurs in the vicinity of the focal plane. If a flat-top laser beam keeping its shape during propagation is needed then this can be obtained by a weighted incoherent mixing of *LG*00 and *LG*01 eigenmodes. Here, we consider the generation of these two transverse modes by a solid-state laser axially pumped by a laser diode. The idea is to design the laser cavity so as to make identical the losses of *LG*00 and *LG*01 modes. To reach this objective we have used two techniques. The first one called as diffractive lies to insert an adequate amplitude mask inside the cavity. The second one called as interferometric consisted to couple the laser to an external cavity. It is important to note that *LG*00 and *LG*01 modes are not spatially in concurrence, i.e. the peak of the *LG*00 appears in the dip of the *LG*01 mode. As a result, the energy extraction from the amplifying medium is improved increasing thus the laser slope efficiency. Theory and experimental verifications have been done for the diffractive and interferometric techniques allowing the generation of a flat-top laser beam keeping its shape from the near-field to the far-field.

Keywords: diffractive optics, intra-cavity laser beam shaping, high order transverse modes, optical beedback