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THE EFFECT OF RESIDUAL SPATIAL HOLE BURNING IN UNIDIRECTIONAL RING LASERS

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A convenient way to achieve efficient single frequency output from a homogeneously-broadened solid-state laser is by using a resonator configuration in which spatial hole burning is avoided. One of the most frequently used techniques employs a unidirectional ring resonator configuration. This approach has proved very successful, particularly with miniature diode-pumped solid-state lasers, and has led to a number of reliable single frequency laser devices (e.g. [1],[2]).

One important feature of this technique, which is often overlooked, is that there is usually present a small amount of residual spatial hole burning, which arises as a consequence of back reflections from resonator components (e.g. imperfect antireflection coatings). The extent to which spatial hole burning occurs is determined mainly by the choice of resonator design and is most pronounced for ring resonators in which the gain medium is in close proximity to a high reflecting mirror. One example of such a resonator would be a monolithic resonator (e.g. [1],[3]), where the dielectric mirrors are coated directly on to the surface of the laser medium. Here, spatial hole burning occurs in the region of the gain medium where the incident and reflected laser beams overlap. Although this region of overlap is usually very small, the resulting spatial hole burning can nevertheless have a significant effect on laser behaviour and, in some circumstances, can limit the maximum single frequency power which can be obtained from the laser.

In this paper we discuss the effect of residual spatial hole burning in unidirectional ring lasers and present a quantitative model which allows us to estimate the maximum single frequency power which can be obtained in any given situation. Using our model we are also able to suggest a strategy for the design of improved single frequency ring lasers with higher output powers.

References

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