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Challenges in developing a Holmium slab laser to pump a rod OPO

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Abstract content
 (Max 300 words)

We have developed a pulsed Holmium slab laser operating at $2\ \mu\text{m}$ as a suitable pump source for a $3 - 5\ \mu\text{m}$ optical parametric oscillator (OPO). Due to the non-linear conversion process, an OPO must be pumped with short, high intensity laser pulses with good beam quality. Slab lasers can handle high output powers but typically suffer from bad beam quality, making it difficult and inefficient to fit the slab beam into a typically rod-shaped OPO crystal. In this paper we present an alternate slab laser design capable of overcoming these inherent problems.

Our Holmium slab resonator design included intra-cavity cylindrical lenses to shape the mode and improve output beam quality and size. An output power of $45\ \text{W}$ was achieved at a $10\ \text{kHz}$ pulse rate with a slope efficiency of 39% and pulse lengths of $\sim 440\ \text{ns}$. Still, with this setup the beam could not be fit into the OPO crystal without clipping and pulse lengths were too long for efficient conversion (according to simulations). The pulse repetition rate was then dropped to $5\ \text{kHz}$ to reduce the pulse lengths to $\sim 133\ \text{ns}$, and an intra-cavity mode filter (a coated prism) was inserted to suppress higher order modes (at the cost of a reduction in output power to $17\ \text{W}$). With all these modifications, the $2\ \mu\text{m}$ beam was successfully focussed down to $\sim 400\ \mu\text{m}$ and fitted into the OPO. The OPO results have been submitted to SAIP 2012 in a separate paper by author W. Koen.

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