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Investigation of Thermal Effects in High Average Power Chirped Pulse Amplifiers VIDYA RAMANATHAN, JINHO LEE, SHENGBO XU, XIAOMING WANG, DAVID REITZE, Department of Physics, University of Florida — High average power ultrafast chirped pulse amplifiers [1] have important applications for high brightness extreme ultraviolet sources and x-ray sources and for applications in materials processing. We have developed a Ti:sapphire regenerative chirped pulse amplifier system capable of producing 5W of amplified output power at repetition rates that can be varied from 5-10 kHz. High pump powers (in excess of 50 W) are required to achieve amplification factors of 10^6 and higher, resulting in significant heating of the crystal and concomitant thermal effects, such as thermal lensing, and thermal birefringence. A detailed characterization of these detrimental thermal effects on the mode profile, optical spectrum, and will be discussed along with measures undertaken to improve the amplifier's overall performance, including cryogenic cooling of the Ti-sapphire crystal, finite element analysis of the heating, thermal compensation based on negative temperature derivatives of the index of refraction, and cavity stability analysis.

[1] S. Backus, et.al., Opt. Lett. **26**, 465 (2001).

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