Thermal scaling laws of the optical Bragg acceleration structure

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The temperature distribution and heat flow in the planar optical Bragg acceleration structure, fed by a train of high-power laser pulses, are analyzed. Dynamic analysis of a high-repetition rate train of pulses indicates that the stationary solution is an excellent approximation for the regime of interest. *Analytic* expressions for the temperature and heat distributions across the acceleration structure are developed. Assuming an accelerating gradient of 1 GV/m and a loss factor similar to that existing in communication optical fibers 1 dB/km ($\tan\delta \sim 10^{-11}$), the temperature increase is less than 1 K and the heat flow is of the order of 1 W/cm^2, which is 3 orders of magnitude lower than the known technological limit for heat dissipation. Obviously, using materials with a significantly higher loss tangent may lead to unacceptable temperatures and temperature gradients as well as confinement difficulties and phase mismatch.

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