Modelling of thermally-induced stress birefringence in a 10 J, 100 Hz diode-pumped Yb:YAG laser

The high heat loads intrinsically associated with high energy, high repetition rate operation require sophisticated thermal management analyses to minimise the impact of thermal effects on laser performance. In particular, non-uniform heat deposition in optical components can lead to thermal aberrations and thermally-induced stress birefringence. This results in depolarisation of the beam, a deterioration of polarisation purity of a beam passing through the affected optic.

We present an overview and the results of thermal stress-induced depolarisation modelling of Yb:YAG gain medium slabs in a multipass, cryogenically-cooled, nanosecond, diode-pumped solid state laser operating at 10 J, 100 Hz for various input polarisation states. We expect these results to aid in the optimisation of future laser systems.

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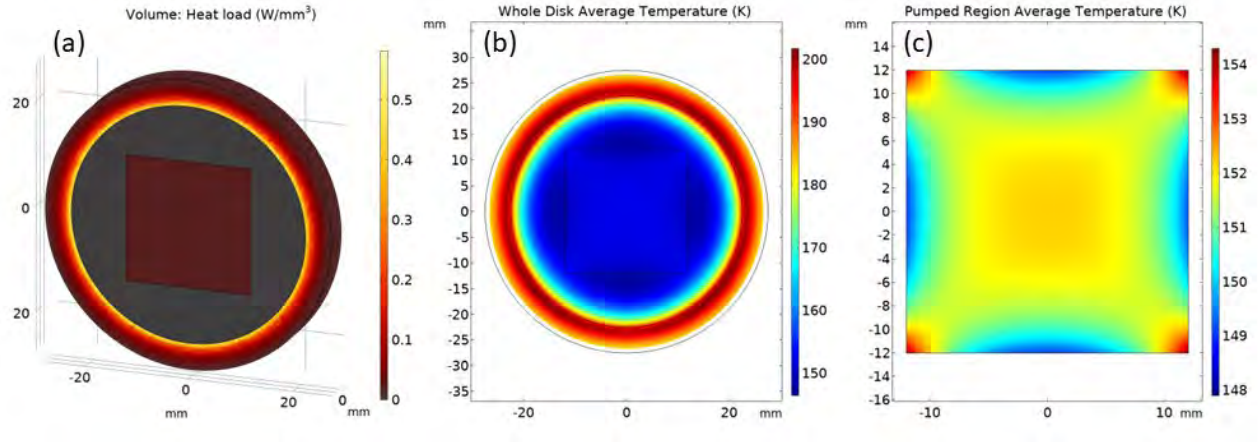

Figure 1: Simulation results showing the heat load distribution within the gain medium slab (a), the temperature distribution in the whole slab averaged over thickness (b), and the temperature distribution in the pumped region averaged over thickness (c)

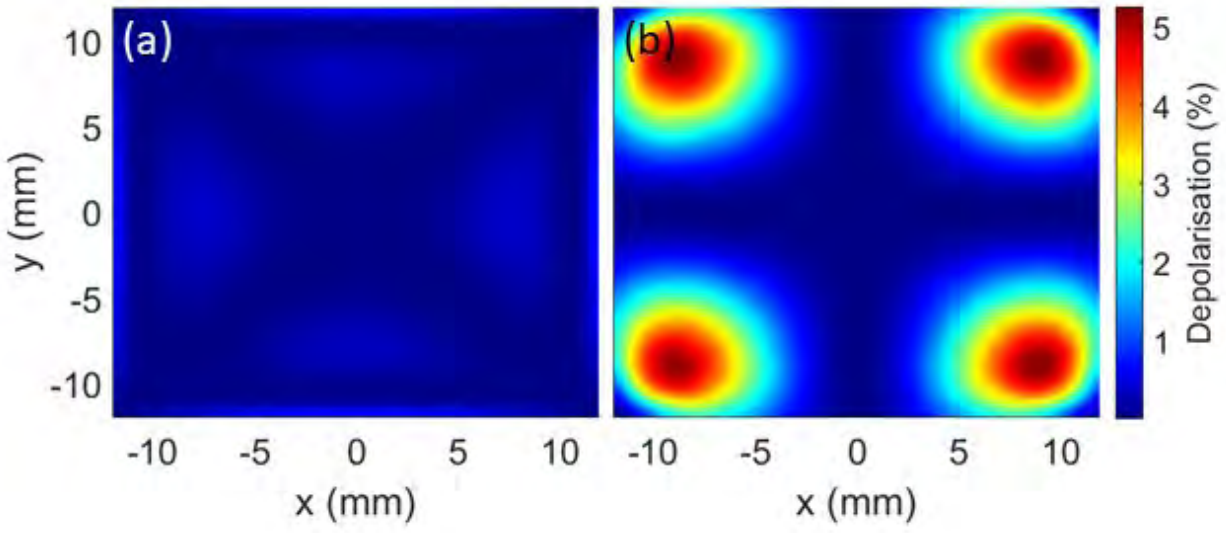

Figure 2: Simulation results showing the single pass depolarisation of a beam propagating through the six gain medium slabs in the amplifier head with an input polarisation state of 45° (a), and 0° (b)