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Inertial confinement fusion and other applications enabled by high energy excimer laser technologies

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NRLs'Nike laser produces up to 3 kJ at 248 nm on target, and was the culmination of simultaneous advancements in pulsed power, the production and control of large area high-energy electron beams, and excimer laser physics. Nike has demonstrated excellent beam smoothing via ISI, the ability to mitigate CBET via focal zooming, the efficient acceleration of targets to high velocity, and the suppression of laser imprint via high-Z layers. KrF is a candidate for providing laser preheat on a future MagLIF facility at Sandia. Excimer lasers are attractive candidates for a future high yield ICF facility because they have broad bandwidth (>1 THz), good target coupling and decreased LPI growth rates (deep uV), and the gas laser media avoids internal damage and facilitates cooling. The driver development path is to demonstrate a 20 kJ amplifier and beamline, which would be the building block of a future high-yield facility (e.g. 1 MJ using 50x20-kJ beamlines). We studying an e-beam pumped ArF (193 nm) system because of its potential for higher intrinsic efficiency and decreased LPI. Inertial fusion energy (IFE) requires repetitive operation at 5-10 Hz. The Electra KrF facility has produced up to 700 joules at a 5 Hz repetition rate, and achieved 105 shot continuous operations with laser-triggered spark gap switched pulsed power. An all solid-state switched pulsed power module has demonstrated >107 shot operation and could be incorporated into Electra. We are also exploring the use of LTD technologies to make a more compact pulsed power driver. The underlying repetitive pulsed power and electron beam technologies have also created the opportunity for derivative applications including the removal of NOx and SOx from the flue gas of fossil fuel plants, the production of biofuels, and material modifications. We will report on preliminary results towards these commercial applications.

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