Advances in Direct Diode Pumped Femtosecond Ti:Sapphire Lasers

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Tiny, affordable laser diodes are replacing bulky, power-hungry frequency-doubled solid-state lasers as pump sources for femtosecond Ti:sapphire lasers. They significantly lowers acquisition costs making femtosecond lasers more accessible globally. While laser diodes enables easy integration into various setups, enhancing portability and stability with lifetimes exceeding 10,000 hours, they drastically reduce maintenance needs and operational risks. Much like the technological shift nearly 30 years ago when frequency-doubled solid-state lasers began to replace large-frame argon-ion gas lasers, these small, energy-efficient and cost-effective laser diodes are going to revolutionize the worldwide access to femtosecond laser pulses in the sub 50 fs range, fueling innovation and enable new companies to bring fs-applications to a much broader market.

We present a comparative analysis of GaInN laser diode-pumped femtosecond lasers developed at VIULASE with internationally published findings. This will include a discussion of the inherent challenges in pumping with laser diodes and the methods employed to surpass these limitations for enhanced output power. Moreover, we will outline biomedical applications focusing on optical coherence tomography and multiphoton microscopy enabled by existing commercial laser systems. Key results will be presented about the development of a sub-10 fs direct laser-diode pumped femtosecond laser aiming at 500 mW output power and demonstrating its potential for multimodal biomedical optical imaging such as morpho-molecular functional drug response analysis of organoids.