Multi-Laser Technology for Clean Energy Applications: Remote Detection and Nano/ Micro Fabrication

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A new class of science and technology is being developed at Missouri S&T using multiple lasers to study the fundamentals of laser-material interaction and laser-based micro/nano fabrication. The new technology integrates two or more lasers, such as femtosecond laser, nanosecond laser and CW laser, with variable pulse durations, tunable wavelengths, and powers, allowing us to "manipulate and control" the chemical reaction path or ablation mode in laser-material interaction. Currently, the new technology is being developed to achieve "resonant" laser energy absorption for photo-dissociation of C_xH_y gases to generate "selected" free radicals that facilitate the formation and growth of diamond thin film in room temperature and open atmosphere. The multi-laser technique is also being used to fabricate miniature fiber sensors, cardiovascular stents, lab-on-a-chip, micro-lens array, and the cutting of silicon wafers.

The new multi-laser technology can have broad applications in Clean Energy research including, for example, 1) in-situ monitoring of gas compositions in the hot-zone of a coal-fired power plant for improving efficiency and reducing pollutant emission; 2) remote detection and identification of trace pollutants (gases or particulates) for environmental management in fossil fuel-based power generation; 3) precision fabrication of micro-lens array for enhancement of the photovoltaic efficiency and microphotonic sensors for process control and monitoring in energy generation; 4) crack-free cutting of solar panels and micro welding for the assembly of fuel cells (laser welding has been identified by DOE as one of the key technologies for fuel cell manufacturing). Through the sponsorship of NSF, ARO, and AFRL, Missouri S&T is equipped with several state-of-the-art laser systems and the associated optics and instruments.