Proceedings Volume 10876, Optical Interactions with Tissue and Cells XXX; 108760K (1 March 2019), SPIE Photonics West Conference, California, USA. From 02-07 February 2019.

Near infrared femtosecond laser-induced bacterial inactivation

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Abstract

The use of light to inactivate microbes as an alternative method to the traditional methods of controlling microorganisms continues to draw the attention of researchers. Traditional methods of sterilization and/or pasteurization using chemicals or thermal treatments have certain limitations such as the creation of resistant bacterial strains. The application of pulsed laser irradiation compromises the physiological function of cells, and the degree of destruction is both dose and strain dependent, ranging from reduced cell growth to a complete loss of cell metabolic activity and finally to physical disintegration. This study aimed at using a range of power densities to investigate inactivation of Escherichia coli and Salmonella enteritidis. A Titanium sapphire pulsed laser at 800 nm wavelength, repetition rate of 76 MHz, pulse duration of 120 fs, output power of 560 mW was used in this study. A fluence range was applied on bacterial cultures in a 16 mm diameter petri with a beam spot area of 2.5 cm2 (after expansion). The laser killing effectiveness was evaluated by comparing colony forming units (CFUs) with and without irradiation on 10-7 dilutions of bacterial cultures. Cytotoxicity was analysed using the lactose dehydrogenase (LDH) assay. The laser killing rate varied with bacteria species or strains and the level of fluence.