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EDITORIAL

Lasers for Biomedical and Material Processing Applications

P. K. Gupta[1]

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Laser is one of the most important inventions of the twentieth century. Due to its remarkable properties it has found widespread applications in all aspects of human endeavour—industry, medicine, defence, basic research and even home entertainment. The exquisite control on laser parameters allows such diverse applications like precision welding of sheets of metal to welding of the delicate layers of retina. This issue addresses some aspects of the use of lasers in biomedical and material processing applications and an attempt has been made to highlight the work being carried out in India in these areas.

The first four articles deal with use of lasers for material processing applications. The article by Padmanabham and Bathe describes industrial applications of the laser based macro (cutting, welding, cladding, alloying, drilling, brazing) and micro processes (micro texturing, scribing, micro drilling etc.). The second article by Bindra and Upadhyaya describes the solid state lasers with appropriate beam delivery systems developed indigenously and their use for refurbishing and maintenance operation of nuclear power plants. The innovative laser based processes have resulted in enormous saving in the radiation dose received by the working personnel and a significant reduction in maintenance shutdown time of the power plants. The article by Majumdar and co-workers describes the use of laser surface engineering techniques for improving the performance of bio-implants made of AISI 316L stainless steel. The article by Patel and Saha describes the different laser based systems developed by Sahajanand Laser Technology Limited to cater to the need of diverse industrial sectors and the impact made by these to Indian industry in particular to the diamond processing industry cluster at Surat.

The next three articles describe the use of lasers to explore biological processes with high temporal or spatial resolution. The article by Krishnamoorthy elaborates how picosecond resolved fluorescence lifetime measurements on polypeptides and proteins can be used to reveal intramolecular distance distribution of partially folded structures and help understand molecular mechanisms of protein folding. The article by Nandi and Bhattacharyya describes the use of femtosecond up-conversion and single molecule spectroscopy techniques for investigating the nanoscopic heterogeneity of ionic liquids and the use of ionic liquids for in situ generation of fluorescent gold nanoclusters inside the live cell for imaging applications. The article by Maity and co-workers describes the design and construction of a line-confocal Raman micro-spectrometer. Because of the multiplexing advantage, it enables achieving good signal to noise ratio at lower Raman laser excitation power compared to commercial Raman microscope, which uses a point-confocal design.

The last four articles describe the applications of lasers or other light sources for biomedical imaging, diagnostics and therapeutic applications. The article by Mehta describes the use of quantitative phase optical microscopic techniques for imaging of red blood cells, oral cancer cells and tomographic sectioning of multilayer biological structures. The article by Swami and Gupta describes the use of optical spectroscopic techniques for in situ, sensitive, minimally invasive diagnosis with emphasis on the use of these techniques for the diagnosis of cancer. The article by Srivastava discusses the models developed for understanding the thermal response of laser-irradiated

✉ P. K. Gupta
pkgupta54@gmail.com

[1] Department of Physics, Indian Institute of Technology Delhi, HauzKhas, New Delhi 110016, India

tissues with a view to optimize the photo-thermal therapy for cancer. The article by Asheesh Gupta and co-workers describes non-thermal therapeutic applications of light and discusses why these can prove to be a very effective therapeutics tool.

We hope that this issue will serve the purpose of a quick reference to several aspects of the work being carried out on the use of lasers for biomedical and material processing applications in India and stimulate further work in these areas.