Structured light offers new laser sciences and structured materials

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Structured light beams, for instance, optical vortex beams with a ring-shaped spatial form and an orbital angular momentum (OAM) owing to their helical wavefront [1], have been currently attracting much attention in a variety of fields, such as optical manipulations [2], optical/quantum communications [3], laser scanning super resolution microscopes [4], and laser materials fabrications [5, 6]. These aforementioned applications strongly desire high quality optical vortex laser sources with versatilities of wavelengths and OAM states.

To date, we have demonstrated the wavelength extension of optical vortex laser sources in the ultraviolet ~ terahertz region by employing both second order and third order nonlinear processes, and we have successfully developed continuous-wave or pulsed tunable optical vortex laser sources with versatile OAM states and moderate energy levels in a visible, near-infrared, and mid-infrared regions [7].

Such versatile vortex laser sources should open an avenue towards novel fundamental sciences and advanced technologies beyond conventional optical tweezers, light-matter interactions, telecommunications, biomedical imaging technologies, and micro-fabrications.

In this presentation, we report on a recent progress of wavelength versatile vortex laser sources based on solid-state laser and nonlinear frequency extension technologies. We also address the state of the art of optical vortex materials processing.

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