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μPIV characterization of a toroidal microfluidic vortex driven by opto-electrokinetic methods JAE-SUNG KWON, STEVE WERELEY, Purdue University — The simultaneous application of a uniform AC electric field and a focused laser to a fluid induces a toroidal microvortex with its center at the laser beam waist. In this paper we analyze the vortex quantitatively using μPIV technique. Also the vortex is characterized with respect to electric field strength, AC frequency, laser power and nonlinear coupling effect of the thermal gradient in the fluid and the electric field. As a result the flow vorticity at a certain constant AC frequency and laser power is found to increase as the square of the electric field strength. And it does not change appreciably in 10–70 kHz range under a fixed electrical voltage and laser power, but starts decreasing from the frequency ($\sim$100 kHz) at which a charge relaxation of the fluid occurs. Also at a constant AC frequency and voltage, the vorticity is significantly enhanced as the laser power is increased from 20 to 170mW due to the nonlinear interaction of the two driving sources—the laser and electric field. These results provide important insights to optimize the design and operation of a novel microvortex based mixer for rapid, dynamic on-chip mixing in progresses.

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