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Optimization of a High-Speed X-Ray Imaging System

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ABSTRACT

Spray-based liquid atomization and liquid mixing is critical for development of efficient combustors and drug delivery systems as well as multiple coating-related applications. While optical methods allow characterization of low density regions of sprays, the scattering of optical photons hinders the characterization of a dense core. Unlike optical photons, higher-energy X-ray photons have the capability to penetrate and image the core structure of sprays. Here we characterized temporal and spatial resolution of an X-Ray imaging system based on a commercially available tube source with an anode size of 0.6 mm. For high-speed imaging, a phosphor screen in combination with a high-speed CMOS camera equipped with a two-stage intensifier was used. Water was used as a model liquid with the addition of potassium iodide to increase the X-Ray absorption coefficient. Two-dimensional images of 0.5mm and 2 mm impinging jet sprays were taken with differing spatial resolutions and potassium iodide mass concentrations. Depending on the spray conditions, optimal imaging settings were found. The technique can be extended to three-dimensional analysis of sprays with multiple viewing angles from two or more X-ray sources along with tomographic reconstruction.

KEYWORDS

Sprays, imaging, X-ray, radiography, spatial resolution, temporal resolution