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Cavitation bubble oscillation period as a process diagnostic during the laser shock peening process

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ABSTRACT:

Laser shock peening (LSP) technology is a laserinduced shock process implemented as a surface enhancement technique to introduce beneficial compressive residual stresses into metallic components. The process employs water to confine and enhance the pressure pulse delivered to the target. For thick water layers, or fully water immersed LSP, a cavitation bubble is generated by the surface vaporization of the LSP laser pulse. This research shows that the first bubble oscillation period of the cavitation bubble can be used to characterize effective and repeatable energy delivery to the target. High-speed shadowgraphy is implemented to show that variations in the bubble period occur before visual observations of dielectric breakdown in water. The diagnostic potential of the first bubble oscillation period is used to identify the dielectric breakdown threshold of water, which shows an increase with increasing water quality measured by water conductivity.