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Air surface microdischarge-photon synergy in antibacterial plasma-activated water[1] DAVID GRAVES, MATHEW PAVLOVICH, HUNG-WEN CHANG, YUKI SAKIYAMA, DOUGLAS CLARK, UC Berkeley — We show that the antibacterial effects of air plasma on water can be amplified by synergy with ultraviolet (UV) photons. We use the surface microdischarge configuration (SMD) in atmospheric air adjacent to bacteria-laden water coupled with UVA (360 nm) photons from a light emitting diode (LED) to demonstrate this synergy. Air SMD, especially if operated in a confined space, can operate in different modes: low power mode (< 0.1 W/cm2) generates primarily O3 whereas higher powers generate mainly nitrogen oxides; we focus here on the latter. The nitrogen oxide mode creates a powerful antibacterial mixture in water, including NO2-, NO3- and H2O2. Although these species alone can be strongly antibacterial, especially at low pH, we show that addition of UVA photons greatly amplifies the antibacterial effect. We first measured log reductions with only photons and then only plasma. Only when UVA exposes water after plasma does the synergy appear. Synergy appears to be due to UVA photolysis of plasma-generated NO2- to form NO and OH. We conclude that combining plasma-generated chemical species with activating photons can amplify and strengthen plasma effectiveness in many biological and other applications.

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