# Plasma-water interactions, and high-efficiency and large-volume generation of plasma-activated water

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Plasma activated water (PAW) has gained increasing attention as potential alternatives to conventional sterilization techniques applied for agriculture [1, 2], food [3,4] and medicine [5, 6]. The main advantages of using PAW for sterilization include less adverse impact on the environment and no risk during storage and transportation [7]. The plasma activated water containing various activated species is formed due to the interactions of water and plasma-generated species. In this study, atmospheric air plasmas have been generated in air nano-bubbles in water or over the surfaces of still and flowing water, and three experimental setups have been used for the preparation of PAW at atmospheric pressure. The spatio-temporal evolution of atmospheric air discharge has been observed by our ICCD measurements. The discharge power and PAW reactivity have been measured, and the effects of discharge power and water conductivity on PAW reactivity have been analyzed. The concentrations of long-lived species in PAW are measured as a function of discharge power and treatment time, and their concentrations are compared. The atmospheric air discharge occurring over the water surfaces has been modeled, and the electron density, plasma potentials, and the concentrations of main reactive species in the gas phase have been obtained as a function of time and discharge power. The energy efficiencies of these plasma-treated methods are compared. The air plasma treatment of flowing water is described in details, and this design is very efficient for generating large-volume PAW. The atmospheric-pressure microplasma applications for sterilization are also reported in this study. Our study shows that the air plasma treatment of flowing water will be very helpful for inactivating the coronavirus both in air and on the surface of a solid.

## References

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