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Towards Plasma-Based Water Purification: Challenges and Prospects for the Future[1]

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Freshwater scarcity derived from climate change, pollution, and over-development has led to serious consideration for water reuse. Advanced water treatment technologies will be required to process wastewater slated for reuse. One new and emerging technology that could potentially address the removal micropollutants in both drinking water as well as wastewater slated for reuse is plasma-based water purification. Plasma in contact with liquid water generates reactive species that attack and ultimately mineralize organic contaminants in solution. This interaction takes place in a boundary layer centered at the plasma-liquid interface. An understanding of the physical processes taking place at this interface, though poorly understood, is key to the optimization of plasma water purifiers. High electric field conditions, large density gradients, plasma-driven chemistries, and fluid dynamic effects prevail in this multiphase region. The region is also the source function for longer-lived reactive species that ultimately treat the water. Here, we review the need for advanced water treatment methods and in the process, make the case for plasma-based methods. Additionally, we survey the basic methods of interacting plasma with liquid water (including a discussion of breakdown processes in water), the current state of understanding of the physical processes taking place at the plasma-liquid interface, and the role that these processes play in water purification. The development of diagnostics usable in this multiphase environment along modeling efforts aimed at elucidating physical processes taking place at the interface are also detailed. Key experiments that demonstrate the capability of plasma-based water treatment are also reviewed. The technical challenges to the implementation of plasma-based water reactors are also discussed.

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[2]I submitted this abstract yesterday through normal submission and not the invited link. That abstract was DPP16-2016-001799. Please remove this accidental submission