Interactions of Porous Dielectric Materials with Atmospheric Pressure Plasmas*

Kseniia Konina, Juliusz Kruszelnicki and Mark J. Kushner

University of Michigan (kseniiak@umich.edu)

Low temperature plasma (LTP) interactions with complex surfaces is of significant interest for functionalization and sterilization. The behavior of LTPs on planar uniform surfaces has been investigated in detail. However, industrial materials typically have rough and non-uniform surfaces. Understanding the interaction of plasmas with such surfaces is important to many applications including catalysis and biomedical materials processing. One important type of nonplanar morphology is a porous surface. In this work, we discuss results from a computational investigation of atmospheric pressure plasma interactions with porous dielectric surfaces and plasma penetration into pores.

This investigation was performed using the 2-D hybrid plasma model *nonPDPSIM* [1]. The model solves Poisson's equation for the electrical potential together with continuity equations for neutral and charged species. The model solves Boltzman's equation to obtain electron energy distribution functions to provide rate coefficients while also accounting for surface charging and secondary electron emission. In this work, surface ionization waves (SIW) were investigated while propagating on a porous dielectric surface in atmospheric pressure humid air. Key differences between positive and negative polarity plasmas in being able to penetrate into pores were identified. The range of applied voltage magnitude that is able to sustain a SIW and penetrate into pores was identified for different polarities. Plasma penetration into pores was studied for different shapes of pores, different size of opening (including close to the Debye length) and varied distance of the pores from the powered electrode.

* Work was supported by DOE Fusion Energy Sciences (DE-SC0020232) and the National Science Foundation (IIP-1747739, PHY-1902878).

References

[1] S. A. Norberg et al, Plasma Sources Sci. Technol. **24**, 035026 (2015).