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# Modeling of Fluxes and Surface Coverage of Plasma-Produced Species on Artificial Bone Scaffolding

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Porous ceramics are used as scaffolding for tissue engineering and bone regeneration. Plasma treatment of porous calcium hydroxyapatite increases cell attachment and adhesion, improving performance as a bone substitute.[1] The mechanisms producing improvement are not well known, but surface coverage of chemisorbed O, OH and N have been correlated with increased wettability, possibly leading to increased cell proliferation. These plasma processes are typically performed at low pressure. Using atmospheric pressure plasmas (APPs) would lower cost, but are challenged to produce uniform plasmas inside the pores.
APPs propagating through pores tens of microns in size in ceramics were computationally investigated using the 2D modeling platform, nonPDPSIM.[2] Plasma was produced in a co-planar dielectric barrier discharge (DBD) by negative ns voltage pulses. The bottom dielectric had chains of pores with 100% interconnectivity. Discharges in air and He/O_{2} mixtures were studied while varying the width and angle of the pore-chain. Plasma propagating from the DBD into the pores initially produces a Townsend-like discharge and surface charging. The surface charging is sensitive to the angle of the pore-chain and can produce restrike-like discharges propagating back towards the plasma. The alignment of the pore-chain with the applied electric fields impacts plasma properties. Surface ionization waves (SIWs) along the curved surfaces of pores most readily form when the pore-chain has a large angle. The high electron temperatures at the head of the SIWs produce higher radical fluxes onto pore surfaces which are progressively less uniform as the pore-chain angle increases. Narrower openings between pores produce less uniform fluxes as propagation of the plasma is inhibited.
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[1] Y. Moriguchi et al., PLoS ONE 13, 3 (2018).
[2] S. Norberg et al., Plasma Sources Sci. Technol. 24, 035002 (2015).

**Authors:** Mr KRUSZELNICKI, Juliusz (University of Michigan); Ms MA, Runchu (University of Michigan); KUSHNER, Mark (University of Michigan)

**Presenter:** Mr KRUSZELNICKI, Juliusz (University of Michigan)

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