GEC19-2019-000133

Abstract for an Invited Paper
for the GEC19 Meeting of
the American Physical Society

Interaction of plasma with organic liquids: Waste-free epoxidation[1]

FELIPE IZA, Loughborough University

Advancements in non-thermal plasmas operating at atmospheric pressure have made possible novel processing of liquids that were not conceivable in conventional vacuum systems due to vapour pressure limitations. In addition to the rapidly growing use in plasma medicine, plasma agriculture, nanoparticle synthesis and water treatment, the interaction of plasmas with organic liquids opens two additional avenues of research: the development of novel organic compounds for the characterisation of plasmas and the use of gas plasma in novel chemical synthesis processes. Of special interest are novel chemical synthesis processes in which one has the potential of eliminating waste streams. In this presentation, we will focus on plasma-driven epoxidation, i.e. the oxidation of alkenes to form epoxides. Owing to the lack of reactivity of oxygen and other small molecular oxygen donors with alkenes, peracids are currently used to drive epoxidation reactions. A widely used peracid is m-chloroperbenzoic acid (mCPBA), which although effective, is also corrosive, explosive, leads to chlorinated waste products and even under optimum epoxidation conditions, it produces more than 10kg of waste stream per kg of oxygen transferred. As an alternative, we can use atomic oxygen generated in an atmospheric pressure plasma, which is delivered to a solution containing the target alkene. This completely eliminates the oxidant waste-stream of the process. Optimization in terms of plasma source configuration, gas composition and input power has allowed us to improve the selectivity and yield of epoxide formation from a few percent in early experiments to ∼80%, which compares favourably with conventional epoxidation processes.

[1]Loughborough Universitys Centre for Doctoral Training in Gas Plasma Interactions with Organic Liquids