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Multi-physics modeling of combustion ignition from an elongated plasma kernel generated by microwave driven metasurface.[1] YUNHO KIM, LAXMINARAYAN RAJA, University of Texas at Austin — We present the multiphysics modeling of combustion ignition phenomena in a hydrogen-air mixture initiated by a microwave surface plasma discharges. The surface plasma is generated over a resonant metamaterial structure that provides sufficient field intensification to breakdown and sustain a discharge under relatively high-pressure conditions of 10's to 100's Torr. Specifically, a surface electromagnetic (EM) wave mode known as the Spoof Surface Plasmon Polariton (SSPP) is excited to yield a hybrid resonance that is characteristic of the coupling of cavity and surface EM wave modes. Motivated by the need for a large, volumetric ignition kernel for applications in combustion ignition, we numerically demonstrate the volumetric surface plasma discharge enabled by the use of this particular EM wave mode in a high pressure operating regime. We discuss the transients evolution of an order 16 mm long plasma kernel and subsequent ignition kernel formation. High density combustion enhancing radical species (O, H, OH) are produced throughout the bulk plasma, which leads to successful ignition.

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