Contribution ID: **848** Type: **Oral**

Atmospheric Pressure Breakdown and Evidence for Field Emission in GHz Split-Ring Resonators

Monday 24 June 2019 16:15 (15 minutes)

Microplasmas generated using microwaves have generated interest in recent years since they have promising qualities such as high-electron densities, breakdown occurring at voltages lower than predicted by Paschen's law, and the potential for remote excitability. One prominent method for generating microwave microplasmas is to employ a microwave split-ring resonator (SRR). However, while some comparative materials studies have been performed at low to moderate pressure, studies of the effect of different materials and fabrication methods at atmospheric pressure has remained absent. In addition, as field emission is expected to play a larger role as gap size is decreased, it is believed that the study of breakdown voltage vs. gap size for sub-100um may help clarify breakdown mechanisms.

Here we study plasma generation in silver and gold SRRs with gap sizes ranging from 100um to less than 10um fabricated using screen-printing, fs- and ns- laser ablation, and focused ion beam milling. Minor forays are also made with regard to SRRs with copper oxide nanowires and e-beam evaporated Cu. Breakdown is studied both in dark conditions and when SRRs are illuminated with deep ultraviolet irradiation. In order to characterize breakdown voltage distributions, we utilize Weibull statistics. Significant differences are found in the performance of SRRs fabricated using different techniques –differences occur due to Q-factor as we found in previous studies, but also independent of Q-factor. In addition, we find that there is a relationship between Weibull modulus and breakdown voltage. Differences in Weibull modulus and breakdown voltage are investigated by analyzing SEM micrographs of the SRR structure near the region of plasma generation. The large differences in SRR breakdown performance under dark conditions is attributed to the lack or presence of seed electrons which could result from field emission.

Author: Mr COHICK, Zane (The Pennsylvania State University)

Co-authors: Dr LANAGAN, Michael (The Pennsylvania State University); Dr WOLFE, Douglas (The Pennsylvania State University); Mr HALL, Benjamin (Lasers for Innovative Solutions)

Presenter: Mr COHICK, Zane (The Pennsylvania State University)

Session Classification: 3.1 Plasma, Ion, and Electron Sources I

Track Classification: 3.1 Plasma, Ion and Electron Sources