Abstract Submitted
for the GEC19 Meeting of
The American Physical Society

Observation of Nonlinear Standing Waves Excited by Plasma-Series-Resonance-Enhanced Harmonics in Capacitive Discharges[1] KAI ZHAO, DE-QI WEN, YONG-XIN LIU, Dalian University of Technology, China, MICHAEL A. LIEBERMAN, University of California, USA, DEMETRE J. ECONOMOU, University of Houston, USA, YOU-NIAN WANG, Dalian University of Technology, China — It is well-recognized that in a very high frequency (VHF) capacitive discharge, standing wave effects come into play that compromise the plasma uniformity. Here we present the first experimental evidence of nonlinear standing waves excited by plasma-series-resonance-enhanced harmonics in low pressure, VHF, parallel plate, capacitively coupled plasmas. Spatial structures of the harmonics of the magnetic field, measured by a magnetic probe, are in very good agreement with simulations based on a nonlinear electromagnetics model. At relatively low pressure, the nonlinear sheath motion generates high-order harmonics that can be strongly enhanced near the series resonance frequencies. Satisfying certain conditions, such nonlinear harmonics induce radial standing waves, with voltage and current maxima on axis, causing center-high plasma density. Excitation of higher harmonics is suppressed at higher pressures, due to more frequent electron momentum transfer collision with the background gas, resulting in improved plasma uniformity.

[1]This work was supported by NSFC (11335004 and 11722541). MAL acknowledges the support of DOE Fusion Energy Sciences (DE-SC0001939). DJE is grateful to NSF (PHY-1500518) and to DOE Fusion Energy Sciences (DE-SC0001939) for financial support.

Kai Zhao
Dalian University of Technology, China

Date submitted: 30 May 2019 Electronic form version 1.4