

Abstract Submitted
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Nonlinear evolution of electron density in microwave plasma source with abnormal-permeability metamaterial OSAMU SAKAI, Kyoto University, YOSHIHIRO NAKAMURA, Kyoto University — High electron-density plasmas beyond cutoff density were generated by high-power microwaves in an abnormal-permeability space, in which negative permittivity achieved in high density plasma makes refractive index real and negative. Experimental results using a high power microwave source and abnormal-permeability metamaterials verify that this plasma generation is in bifurcated states: high density and low density cases. This indicates that the process is quite nonlinear, partly predicted by our previous study [1]. In the case of negative permeability, after high-density plasma generation, transmitted microwaves increased, which is quite abnormal in usual microwave plasma sources. In the case of near-zero permeability, we also observed high-electron-density or overdense plasmas. Our previous report [2] demonstrates “plasma metamaterials” which include array of microplasmas and metallic microstructures with functional roles as media of electromagnetic waves with small amplitudes. The state of plasmas generated by high-power microwaves and immersed in the metallic metamaterial microstructures will open novel functions of plasma metamaterials; they are nonlinear metamaterials for scientific interests, potential high-density microwave sources for plasma processing, and potential switches for high-power microwaves.

[1] O. Sakai et al., J. Appl. Phys., vol. 109 (2011), 084914.

[2] O. Sakai et al., Plasma Sources Sci. Technol., vol. 21 (2012), 013001.

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