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### **Negative-permittivity plasma generation in negative-permeability metamaterial space**

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Negative-permittivity plasma is generated in negative-permeability metamaterial space. Unlike cases of positive permeability, which is quite usual in almost all materials available so far, negative-permeability space realized in metamaterial structure [1] allows microwaves to propagate in negative-permittivity media. Our previous study [2, 3] verified that microwaves can propagate in a negative-permittivity plasma immersed in a negative-permeability metamaterial space, which indicates that a dynamic state of negative refractive index was successfully generated. In this study, negative-permeability space was prepared using metamaterial structure as well, and we investigated plasma generation by high-power microwaves in such a metamaterial structure. Langmuir probe measurement revealed that electron density is higher than the cutoff density, which means that permittivity is negative [4, 5]. We also confirmed in both model predictions [6] and experimental results [4, 5, 7] that nonlinear phenomena are key issues to understand underlying physics; they include bifurcations of permittivity or electron density in nonlinear dynamics and harmonic wave generation similar to that reported in nonlinear optics, and both phenomena are observed in experiments.

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