

Abstract Submitted
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Second-harmonic generation in composite of microwave plasma and cm-order metamaterial AKINORI IWAI, YOSHIHIRO NAKAMURA, OSAMU SAKAI, Kyoto University — Second-harmonic generation was observed by high-power microwave propagation in composite space of plasma and cm-order metamaterial. In principle, high-power electromagnetic waves induce nonlinear polarization and harmonic-wave generation in plasma, because plasma is nonlinear dielectric medium. However, plasma frequency dispersion prevents propagation of fundamental waves; the increase in electron density leads to the evolution of plasma frequency that behaves as a cut-off frequency, and plasma dielectric constant for fundamental waves becomes negative. To remove this difficulty, our setup combines plasma and double-split-ring resonator(DSRR) or another metamaterial, whose negative permeability has been verified theoretically and experimentally [1] in order to cancel out the cutoff property of negative permittivity using negative permeability: refractive index becomes a real and negative value. By enabling electromagnetic waves to propagate into high-density plasma, intense harmonic generation occurs. Our has reported unique properties of plasma metamaterial [2]. In this study, we experimentally observed second harmonic generation (at 4.9 GHz) in plasma space with DSRR at incident microwave frequency of 2.45 GHz.

- [1] J. B. Pendry *et al.*, IEEE Trans. Microw. Theory Tech. **47** (1999) 2075.
[2] O. Sakai *et al.*, Plasma Sources Sci. Technol., **21** (2012) 013001.

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