Abstract Submitted
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Tunable negative refraction device composed of negative-permittivity plasma and negative-permeability metamaterial OSAMU SAKAI, University of Shiga Prefecture, AKINORI IWAI, Kyoto University, FABIO RIGHETTI, BENJAMIN WANG, MARK CAPPELLI, Stanford University — Negative-refractive-index devices that have been reported to date have been based on solid-state metamaterials. To overcome their limitations of fixed or very-narrowly-variable parameters, we report here on a design that incorporates gaseous plasma components, i.e., discharge tubes filled with Ar at 250 Pa, in which the permittivity is variable and rendered negative by tuning the discharge power [1], together with metamaterial supporter plates that contribute a negative permeability over a specific frequency band [2]. The experimental results within and outside of this band showed remarkable contrast. Outside the band of negative permeability, transmitted microwaves suffered from heavy damping, while recovering in transmitted amplitude with increased discharge power when the plasma contributes negative permittivity inside the negative-permeability band. In addition, strong changes in the phase of the transmitted microwaves were seen when the permeability was negative and the permittivity of plasmas was also tuned to be negative. Similar physical processes, like the abnormal recovery of the microwave amplitude and the extraordinary steepness of the phase shift are reproducible in our theoretical calculations. [1] B. Wang and M. A. Cappelli, Appl. Phys. Lett. 108, 161101 (2016). [2] Y. Nakamura, A. Iwai and O. Sakai, Plasma Sources Sci. Technol. 23, 064009 (2014).

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