プラズマメタマテリアル層によるマイクロ波の迂回現象

Detouring of microwaves through plasma-metamaterial layer 井波 柱偉¹、Alexandra Bambina¹、岩井 亮憲^{1,2}、宮城 茂幸、⁰酒井 道¹ (1. 滋賀県立大工、2. 京都大院工)

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1. Introduction

A plasma metamaterial is a composite of plasma and solid metamaterials, exhibiting various extraordinary features in contrast to normal microwave media [1]. One of the advantages in plasma metamaterials is tunability in their internal parameters, but for regulation of microwaves paths [2], spatial gradients of electron density and permittivity play significant roles. So far, microwave detouring or *cloaking* was achieved using solid-state metamaterials. In contrast, we have reported that, due to these gradients, compactness of the detouring layer is possible, which is a good technological merit [3]. In this study, we show experimental results on flat propagation of microwaves without large wave scattering.

2. Methods

Details of the experimental setup was in Ref. [2], and here we briefly describe it with additional component: array of double split ring resonators (DSRRs). DSRRs make the layer anisotropic since their responses against magnetic field is concentrated on one direction, perpendicular to their 2-dimensional surface. Then, its combination with the spatial gradient that plasma possesses theoretically completes a cloaking function that indicates no scattering of microwaves, based on transformation optics [3]. We launched microwaves on one side of the object (metallic pole) covered with the plasma-metamaterial-layer.

3. Results

Figure 1 shows measured profiles of detected microwave signals in cases with and without plasma. In comparison with a non-flat profile in the case without plasma, we observed a fairly flat profile in the case of plasma generation. Numerical simulation in the similar parameters to this experiment reveals total scattering intensity of propagating microwaves, which indicate that this plasma-metamaterial composite layer works as a cloaking layer.

References [1] O. Sakai et al., Plasma Sources Sci.



Fig. 1. Effect of plasma generation on microwave detouring. (a) Experimental setup. (b) Profiles of detected microwaves on other side of object.

Technol. **25**, 055019 (2016). [2] O. Sakai *et al.*, Plasma Phys. Contr. Fusion **58**, 014042 (2017). [3] A. Bambina *et al. AIP Advances* **8**, 015309 (2018).