Hindawi Publishing Corporation
International Journal of Antennas and Propagation
Volume 2015, Article ID 982325, 2 pages
http://dx.doi.org/10.1155/2015/982325

Editorial

Recent Advances in Theory and Applications of Electromagnetic Metamaterials

Weiren Zhu,[1] Ivan D. Rukhlenko,[1,2] Roman E. Noskov,[3] Ronghong Jin,[4] and Ji Zhou[5]

[1] *Advanced Computing and Simulation Laboratory (AχL), Department of Electrical and Computer Systems Engineering, Monash University, Clayton, VIC 3800, Australia*
[2] *ITMO University, Saint Petersburg 197101, Russia*
[3] *Max Planck Institute for the Science of Light, 91058 Erlangen, Germany*
[4] *Department of Electronic Engineering, Shanghai Jiao Tong University, Shanghai 200240, China*
[5] *State Kay Lab of New Ceramics and Fine Processing, School of Materials Science and Engineering, Tsinghua University, Beijing 100084, China*

Correspondence should be addressed to Weiren Zhu; weiren.zhu@monash.edu

Received 28 July 2015; Accepted 28 July 2015

The advancement of modern electromagnetic technologies strongly relies on the development of original theoretical approaches and new artificial materials. Metamaterials are recently developed artificially engineered materials made of subwavelength electric circuits instead of atoms or molecules, which are the basic elements interacting with electromagnetic radiation. The design of metamaterials enables intriguing applications and manipulating electromagnetic waves in many ways beyond those achievable with natural materials. For the purpose of fully realizing the potential of metamaterials, this special issue aimed to attract original research and review articles that will stimulate the continuing efforts on the understanding of metamaterials and exploring their applications in electromagnetic engineering. The issue has received a total of 27 submissions, 8 of which were accepted for publication after peer reviewing. The accepted papers cover a broad area of metamaterial in both theory and applications.

The paper "Taming the Electromagnetic Boundaries via Metasurfaces: From Theory and Fabrication to Functional Devices" by X. Luo et al. presents a comprehensive review of the history and recent development of metasurfaces. More specifically, this paper focuses on the theory and applications relating to the frequency response, phase shift, and polarization state control. Based on the current status of various applications, some of the open challenges and future trends towards the application of metasurfaces are discussed.

A review titled "Recent Advances in the Modeling of Transmission Lines Loaded with Split Ring Resonators (SRRs)" by J. Naqui et al. presents the progress achieved in the modeling of coplanar waveguide transmission lines loaded with SRRs, that is, negative-permeability transmission lines. This review includes a comprehensive discussion on the effects of SRR orientation, coupling between the adjacent resonators, and coupling between the two SRRs constituting the unit cell.

The mechanism of resonances in the reverse Vavilov-Cherenkov radiation produced by a charged-particles beam propagating over periodic boundary of a dispersive left-handed medium is studied by G. Granet et al. in their paper "Resonances in Reverse Vavilov-Cherenkov Radiation Produced by Electron Beam Passage over Periodic Interface." Conditions of radiation initiation, radiation intensity, and the possibility of the existence of different resonant effects in the reverse Vavilov-Cherenkov radiation associated with the excitation of surface waves of the periodic boundary have been studied both analytically and numerically in the approximation of a given current.

By making an analogy to the quantum counterpart in their paper "Photonic Wannier-Stark Ladder from Coupled Electromagnetic Cavities," S. Anwar et al. present an innovative photonic Wannier-Stark ladder in the system of coupled electromagnetic cavities, where the tilted potential effect is mimicked by imposing the gradient variation of refractive

index. The geometrically progressed eigen energies of the photonic Wannier-Stark ladder are studied through both analytical derivations and numerical simulations.

In their paper "Polarization-Independent and Angle-Insensitive Metamaterial Absorber Using 90-Degree-Rotated Split-Ring Resonators," J.-Q. Feng et al. present the design, simulation, and measurement of a polarization-independent and angle-insensitive metamaterial absorber. They take four subwavelength split-ring resonators with a 4-fold rotational symmetry to build a unit cell of the absorber, which leads to its insensitivity with respect to both polarization and incident angle of planar electromagnetic waves. The performance of such a metamaterial absorber is examined by both numerical simulations and microwave experiments in the X-band.

Metamaterials made of high-permittivity dielectric resonators offer a low-loss alternative to metal-based metamaterials. T. Luo et al., in their paper "Dielectric Behavior of Low Microwave Loss Unit Cell for All Dielectric Metamaterial," present the preparation and characterization of calcium titanate ($CaTiO_3$)—a kind of incipient ferroelectrics with high dielectric permittivity and low loss, which can be utilized for constructing all-dielectric metamaterials. The prepared $CaTiO_3$ exhibits a high microwave permittivity of about 167 with a dielectric loss of only 0.0005, resulting in a quality factor as large as 2049.

The paper "High-Directivity Antenna Array Based on Artificial Electromagnetic Metamaterials with Low Refractive Index" by Z. Xiao et al. reports on an innovative high-gain patch antenna array using a metamaterial. By covering a metamaterial of low refractive index, the antenna array has advantages in terms of smaller number of array elements, larger element spacing, and simpler feeding network. The metamaterial antenna array also features significantly improved directivity and antenna gain.

In their paper "Compact Microstrip Bandpass Diplexer Based on Twist Revised Split Ring Resonators," J. Li et al. experimentally demonstrate a compact microstrip bandpass diplexer, which has two close frequency channels centered at 2.16 and 2.91 GHz. The synthesized diplexer has very simple configuration and is of small size and can be potentially integrated into miniaturized RF/microwave integrated circuits.

Acknowledgments

The authors would like to thank the International Journal of Antennas and Propagation for the opportunity to serve as guest editors of this special issue. They also sincerely thank all the authors for their contributions in this special issue and their patience with the editorial and review processes. They hope readers find interest in the papers in this special issue.

Weiren Zhu
Ivan D. Rukhlenko
Roman E. Noskov
Ronghong Jin
Ji Zhou