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Photonic metamaterials for InP-based optical communication devices

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Photonic metamaterials offer new opportunities for innovation in the field of electromagnetic parameter design, such as the design of permittivity ε and permeability μ. The major focus of attention is to create artificial materials with unique ε-μ values that cannot be observed in any existing media and to take advantage of these expanded parameters for better control of electromagnetic waves. Recent progress in photonic metamaterials has allowed researchers to move material properties away from the non-magnetic line μ=1 and has opened the third quadrant of the parameter space (i.e., ε<0 and simultaneously μ<0), which was previously inaccessible. One of the next trends in this field is to think of metamaterials as devices, where the structuring of metal and the hybridization with functional agents brings new functionality. Especially, introducing photonic metamaterials into actual optical communication devices poses an exciting challenge. Much effort has been expended in the development of advanced optical applications using the concept of metamaterials; leading examples of such applications include MEMS actuators with split-ring resonators and Si-based optically-controlled modulators that can perform negative-index tuning. In this talk, we report InP-based optical communication devices combined with metamaterials to show the possibility of permeability control on the semiconductor-based photonics platform. As an actual device, we demonstrate an electrically-driven permeability-controlled optical modulator, which shows great promise for using both the permittivity and permeability in semiconductor-based photonic devices.

Biography

Tomohiro Amemiya received his Ph.D. degree from the University of Tokyo, Japan, in 2009. In 2009, he moved to the Quantum Electronics Research Center (QNERC), Tokyo Institute of Technology, where he is currently an Assistant Professor. His research interests are in the physics of semiconductor light-controlling devices, metamaterials for optical frequency, magneto-optical devices, and in the processing technologies for fabricate these devices. He was the recipient of the 2007 IEEE Photonics Society Annual Student Paper award, the 2008 IEEE Photonics Society Graduate Student Fellowships, and 2012 KONICA MINOLTA Imaging award.

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