139. Title: Metamaterials: a new frontier of science and technology

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Abstract: Metamaterials, artificial composite structures with exotic material properties, have emerged as a new frontier of science involving physics, material science, engineering and chemistry. This critical review focuses on the fundamentals, recent progresses and future directions in the research of electromagnetic metamaterials. An introduction to metamaterials followed by a detailed elaboration on how to design unprecedented electromagnetic properties of metamaterials is presented. A number of intriguing phenomena and applications associated with metamaterials are discussed, including negative refraction, sub-diffraction-limited imaging, strong optical activities in chiral metamaterials, interaction of meta-atoms and transformation optics. Finally, we offer an outlook on future directions of metamaterials research including but not limited to three-dimensional optical metamaterials, nonlinear metamaterials and "quantum" perspectives of metamaterials