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Title: Negative Index of Reflection in Planar Metamaterial Composed of Single Split-Ring Resonators

Author: Tang, MC Xiao, SQ Wang, D Xiong, J Chen, K Wang, BZ

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Abstract: This paper reports the negative index of refraction in planar metamaterial consisted of only a traditional single split-ring resonator (SRR), which is proved to exhibit simultaneously negative permittivity and negative permeability without the use of assistant metallic structures by retrieving the effective electromagnetic parameters. With the aid of current distributions investigation, it is demonstrated that within the left-handed band the negative permittivity is generated in a way analogous to the case of dual parallel cut-wire metamaterial, and negative permeability arises from the asymmetric second-order magnetic resonant mode.