Positive–Negative Birefringence in Multiferroic Layered Metasurfaces

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We uncover and identify the regime for a magnetically and ferroelectrically controllable negative refraction of a light-traversing multiferroic, oxide-based metastructure consisting of alternating nanoscopic ferroelectric and ferromagnetic layers. We perform analytical and numerical simulations based on discretized, coupled equations for the self-consistent Maxwell/ferroelectric/ferromagnetic dynamics and obtain a biquadratic relation for the refractive index. Various scenarios of ordinary and negative refraction in different frequency ranges are analyzed and quantified by simple analytical formula that are confirmed by full-fledge numerical simulations. Electromagnetic waves injected at the edges of the sample are propagated exactly numerically. We discovered that, for particular GHz frequencies, waves with different polarizations are characterized by different signs of the refractive index, giving rise to novel types of phenomena such as a positive–negative birefringence effect and magnetically controlled light trapping and accelerations.

References

[1] R. Khomeriki, L. Chotorlishvili, I. Tralle, and J. Berakdar, “Positive–Negative Birefringence in Multiferroic Layered Metasurfaces”, Nano Letters, **16**, 7290, (2016).