

# Switching the electric and magnetic responses of metallic microstructures at the same frequency: an approach to realize negative refractive index

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Control the transmission of electromagnetic (EM) waves is an important issue in optics. The magnetic and electric resonances of the same metallic microstructure are shown to be switchable at the same frequency band by simply rotating the polarization of incident light by  $90^\circ$ . This property originates from the constructive /deconstructive superposition of electric and magnetic responses of four orthogonally placed U-shape resonating (USR) elements. Although each individual resonator exhibits distinctive electric and magnetic responses, the collective response of all the resonators in the unit can be purely electric or magnetic. In USR, once the horizontal bar in the U-shape is moved to center of the vertical bars, an H-shaped metallic resonator is constructed. We further show that both the magnetic and the electric resonances can be realized simultaneously at the same frequency band. Negative refractive index (NRI) is consequently realized. The frequency band with NRI can be tuned by the structural parameters of the H-shaped resonators. This design demonstrates a unique example to construct metamaterial with negative refractive index.

## References

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