# Hyperbolic Metasurfaces

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Uniaxial materials with opposite signs of permittivity for ordinary and extraordinary waves are characterized by hyperbolic dispersion, i.e. the wavevector of a plane wave in these media follows the surface of a hyperboloid in contrast to an ellipsoid for conventional anisotropic dielectric [1]. This property enables unusual electromagnetic response, such as broadband negative refraction without artificial magnetism, and are very attractive for a large number of applications, like nano-imaging, nano-sensing, thermal emission engineering, control of emission and absorption and sub-diffraction imaging. For this reason, in the last year there has been a great effort in the development of artificially structured hyperbolic metamaterials [2].

Similarly, artificial surfaces, or metasurfaces (MTSs) can be engineered to support surface waves with hyperbolic dispersion [3]. This may allow for enhanced resolution, imaging, lensing and surface waves canalization. This latter has an enormous application potential in flat devices, on-chip networks, optical signal control and scanning metasurface antennas. The realization of dual-polarized hyperbolic MTSs with polarization degeneracy is of particular interest for many applications; however, the dispersion curves of TE and TM surface modes are not generally degenerate, except for accidental intersections at several points, in sharp contrast to the plane waves in isotropic media.

This paper presents a novel class of metasurfaces supporting at low frequency two quasi TE and TM surface-waves modes with hyperbolic dispersion and identical dispersion characteristics along the principal axes. The MTSs consist of a sequence of complementary (capacitive and inductive) strips, leading to a self-complementary structure. Polarization degeneracy is a consequence of self-complementarity [4] and it has been verified both numerically and experimentally for the specific self-complementary structure shown in Fig. 1. It is also seen that group velocity drastically changes depending on the direction of propagation of the surface waves, becoming extremely low for the direction of propagation orthogonal to the strips.

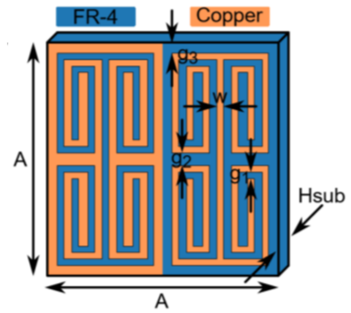


**Figure 1.** Unit cell geometry for the proposed hyperbolic MTS.

## References

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