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Left handled materials in millimeter wavelength region

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We demonstrate a type of composite meta-materials, which is constructed by combining thin copper wires and split ring resonators on the same board. Using the analysis of the phase delay of one-dimensional structures of meta-material, we reached the optimal structure parameters. Using the optimized target parameters we had investigated the orientation-angular dependence of radiation refraction in meta-material target. The measurements were performed in free space as well, as the spectral characteristics of refracted radiation in comparison with the initial spectra. The measured dependences show the formal correspondence of the radiation characteristics to the negative refraction index of the meta-material structures. This correspondence is only formal one, which follows from the Snellius law, because really the permittivity and the permeability should be considered as macroscopic tensor characteristics of meta-material targets. But such viewpoint is usually applicable.

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