Analytic theory and simulations in the particle-in-cell code ICEPIC are used to describe the interaction of an electron beam in a parallel plate waveguide partially loaded with a metamaterial structure. The metamaterial being considered is an effective medium representation of a split ring resonator (SRR) and isotropic wire rod material. The functional forms of the effective medium for the material being considered are taken from [1] and are implemented in the ICEPIC code by the method described in [2]. The parallel plate geometry has a thin electron beam on axis and a central region of vacuum with the metamaterial located along the metal waveguide walls. An analytic dispersion relation describing the interaction is derived based upon [3]. ICEPIC simulations are used to determine the interaction mode and growth rate as a function of beam current.


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