非线性左手材料中的差频耦合

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摘要　　基于非线性电磁理论，推导了无耗非线性左手材料中差频耦合波方程，由此方程分析了相位匹配条件下信号波与差频波的反向能量转换过程及其空间分布．发现有限厚度的非线性左手介质板能够得到比右手材料更大的信号波和差频波能量输出．因此可利用非线性左手材料制备更加小型化的微波放大器，并通过参量调节来控制材料的左、右手特性，从而实现信号波输出方向可调的小型微波放大器件．

Difference-frequency coupling in nonlinear left-handed metamaterials

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Abstract

Based on the nonlinear electromagnetic theory, general coupled-mode equations for difference-frequency coupling in nonlinear left-handed metamaterials(LHM) are studied. The co-directed energy conversion process and spatial distribution of the signal wave and difference-frequency wave under the phase-matching condition are investigated. It is shown that through a finite LHM slab, more output power of the signal wave and difference-frequency wave than through an RHM slab with the same thickness can be obtained. For this peculiar property, the nonlinear LHM may be utilized to design novel compact RF/microwave amplifiers. And through parameters adjustment of the material to control left-handed or right-handed properties, compact microwave amplifiers of the tunable output direction may be realized.

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