Slow-than-light Transportation of Microwave through Subwavelength Fractal Slots

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Recently, we have found that high electromagnetic wave transmissions can be achieved for a metal plate perforated by slots arranged in fractal geometry at wavelengths much larger than the cross sectional dimensions of fractal slots, and that the transmission is independent on the incident angle, plate thickness, or array periodicity [1,2]. Now, we investigate the wave transportation in time domain through the subwavelength fractal slots at the transmission peak. Both experimental and theoretical results reveal a slow-than-light phenomenon. For example, the time delay can reach 1.3 ns for a microwave pulse to propagate through a 7.7 mm thick metal plate with the fractal slots, which means a reduced group velocity of c/50. The time delay or the reduction in group velocity for a metal plate of thickness given is determined solely by the geometric of fractal slots, because the transmission is caused by a subwavelength resonance which is the transversal shape resonance localized in the metallic slots with axial wave number $k = 0$. The time delay can also be tuned by filling dielectrics into the fractal slots where the fields undergo a significant enhancement.

REFERENCES

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