Ultra-broadband Acoustic Barrier based on Hyper-dampened Fano resonance

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Ultra-broadband sound reduction schemes covering living and working noise spectra are of high scientific and industrial significance. Here we report, both theoretically and experimentally, on an ultra-broadband acoustic barrier assembled from space-coiling metamaterials (SCMs) supporting two Fano resonances. Moreover, acoustic hyper-damping is introduced by integrating additional thin viscous foam layers in the SCMs for optimizing the sound reduction performance. A simplified model is developed to study sound transmission behavior of the SCMs under a normal incidence, which sets forth the basis to understand working mechanism. An acoustic barrier with 220 mm thickness is then manufactured and tested to exhibit ultra-broadband transmission loss(TL) overall above 10 dB across the range 0.44−3.85kHz, covering completely nine third-octave bands. In addition, unconventional broadband absorption in the dampened barrier (65%) are experimentally observed as well. We believe this work paves the way for realizing effective broadband sound insulation, absorption and sound wave controlling devices with efficient ventilation.