Abstract Submitted
for the MAR10 Meeting of
The American Physical Society

Acoustic Surface Evanescent Wave and Its Dominant Contribution to Extraordinary Acoustic Transmission and Collimation of Sound[1]

MINGHUI LU, YU ZHOU, LIANG FENG, XU NI, CHENG HE, YANFENG CHEN, National Laboratory of Solid State Microstructures and Department of Materials Science and Engineering, Nanjing University — Recently, extraordinary acoustic transmissions (EAT) through both one dimensional and two dimensional subwavelength acoustic gratings were demonstrated and investigated in both experiment and theory. In this talk, we demonstrate both theoretically and experimentally the physical mechanism that underlies the novel effects of EAT and collimation of sound through a one-dimensionally decorated plate. A microscopic theory considers the total field as sum of the scattered waves by every periodically aligned groove on the plate, which divides the total field into far-field radiative cylindrical waves and acoustic surface evanescent waves (ASEWs). Different from the well-known acoustic surface waves like Rayleigh waves and Lamb waves, ASEW is closely analogous to surface plasmon polariton (SPP) in the optical case. By mapping the total field, the experiments well confirm the theoretical calculations as well as the fact that EAT and sound collimation take place at the proper frequency when ASEWs satisfy the phase matching condition. The establishment of the concept of ASEW provides a new route for the integration of subwavelength acoustic devices with structured solid surface.

[1]The work was jointly supported by the National Basic Research Program of China (Grant No. 2007CB613202) and the National Nature Science Foundation of China (Grant No. 50632030).

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Date submitted: 30 Nov 2009 Electronic form version 1.4