Recent Developments in Sonic Crystals

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The properties of sonic bandgap crystals will be reviewed and recent results obtained by our group will be reported. Particularly, the homogenization method based on multiple scattering theory will be presented and applied to the case of two-dimensional (2D) structures consisting of fluid-fluid and solid-fluid composites [1, 2]. The method is general and it is employed to get the effective parameters of 2D clusters consisting of solid or fluid cylinders embedded in a non-viscous fluid or gas. Analytical formulas for the effective density and sound speed of the homogenized system were obtained. Experiments will be also reported for the case of a circular cluster of wooden cylinders embedded in air. Also, it will be shown that clusters made of certain "magic" numbers of cylinders show extraordinary scattering properties allowing its use as building blocks of metamaterials that effectively behave as true fluid-fluid composites [3]. Finally, I will present measurements showing the existence of Bloch oscillations and resonant Zener-like effect for sound waves propagating through ultrasonic superlattices made of water cavities and layers of methyl methacrylate [4]. This is the simplest system used to date demonstrating the acoustic analogue of these two phenomena previously shown in semiconductor superlattices.

[1] D. Torrent, A. Hakansson, F. Cervera, and J. Sánchez-Dehesa, Phys. Rev. Lett., Vol. 96, 204302 (2006).
[2] D. Torrent and J. Sánchez-Dehesa, Phys. Rev. B, Vol. 74, 224305 (2006).
[3] D. Torrent, J. Sánchez-Dehesa, and F. Cervera (submitted to Phys. Rev. Letter.).
[4] H. Sanchis-Alepuz, Yu. A. Kosevich and J. Sánchez-Dehesa (submitted to Phys. Rev. Lett.)