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Disorder distribution of scatterers for broadband acoustic transparency

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Broadband transparency is reported in this work by a disordered distribution of scatterers. In the Born approximation, the structure factor of the array of scatterers can be directly related by the scattered intensity which will depend on the position of the scatterers in the system. By using this property, different kind of materials can be designed as for example hyperuniform materials or super ideal gases. In this work we analyze the case corresponding to disorder distributions of scatterers having zero structure factor, i.e. suppressing the scattering of the system and as a consequence being transparent. This kind of systems are known as stealth materials. By using an optimization method, we can design 1D disorder arrays of scatterers having those properties for a broadband range of frequencies. The analyzed system consists of a cylindrical waveguide in which N scatterers are made by changing the section of the main waveguide (diaphragms) at N different positions. The system is characterized by the transfer matrix method as the system is considered in the plane wave propagation region (1D). If the N scatterers are periodically placed in a length L, it is known that at the Bragg frequency strong scattering happens. We design the stealth material in order to suppress the Bragg scattering and to have a transparent behavior at this range of frequencies. Particularly, we analyze the unavoidable effect of viscothermal losses for the case of acoustics showing that the design is robust to the presence of losses. These preliminary results show the possibility to the design of broadband transparent materials by scattering cancellation produced by the N scatterers.