Resonance transmission and flexural waves in structured ceramic plates

Stewart Haslinger *, Natasha Movchan *, Alexander Movchan * and Ross McPhedran *,**

* Department of Mathematical Sciences, University of Liverpool, Liverpool, United Kingdom

**CUDOS, School of Physics, University of Sydney, Sydney, Australia

Abstract

In this paper we study propagation of flexural waves in thin ceramic plates containing structured interfaces, which consist of either arrays of pinned points or rigid inclusions of finite radius. We analyse resonant interaction and trapped waves in such structures and identify system designs that possess high quality factor resonances in transmission. We also give examples of systems where a resonant maximum in transmission is cut in two by a resonant minimum (a phenomenon similar to Electromagnetically Induced Transparency).

The paper addresses the interaction of flexural waves in thin ceramic plates with stacked gratings of impurities, which may be created by blisters during glazing, as well as the micro-structure design. The governing equation involves the biharmonic operator. The multipole method is used to construct an analytical solution of a scattering problem for a single grating that is then used in a recurrence procedure to evaluate the reflection and transmission matrices for a finite stack of gratings. The latter matrices are employed to study transmission resonances and trapped waves in such systems.

It is shown that high quality factor resonances can be obtained for systems of finite number of gratings. The main focus of the work is on the novel phenomenon of the Elasto-Dynamically Inhibited Transmission (EDIT) discovered specifically for structured plates. We discuss how it is related to the occurrence of trapped modes of even and odd symmetries being simultaneously resonant. We also present examples that illustrate the effect of the radius of the inclusion and the layout of the stack on transmission resonances and the EDIT phenomenon.

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