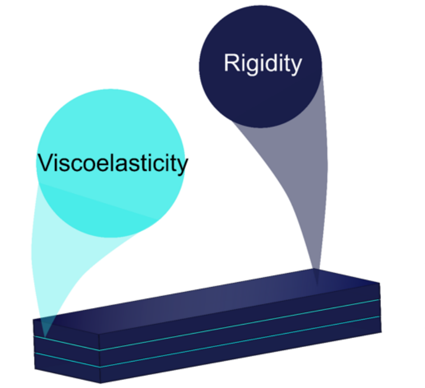
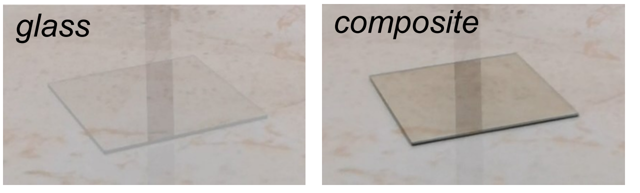
ETH zürich

Licensing Opportunity

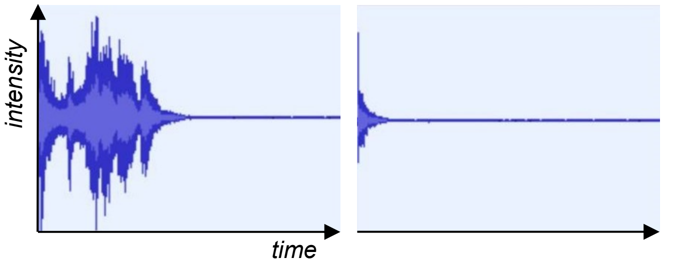
Stiff and lossy materials for noise cutting and vibration damping



Schematic of composite with thin viscoelastic layers sandwiched between flat stiff components.



Photos of glass (left) and glass/PDMS composite (right)



Comparative behavior of glass (left) and a composite (right) falling from 25 cm onto a hard surface. Glass produces a high intensity sound and bounces on the surface. The composite produces a low noise upon impact without bouncing.

Application

A composite material combines properties, which are usually mutually exclusive: high stiffness linked with high vibration damping. This odd combination allows the use of stiff materials such as glass and metal in scenarios where vibration or noise damping is essential. The added polymer is transparent which works for glass windows or displays. The minimal added weight lends itself to lightweight applications such as electronics.

Features & Benefits

- applicable to e.g. glass, silicon, steel, or ceramics
- no additional vibration suppression needed
- simple fabrication
- recyclability of stiff material maintained

Publication

- "Lightweight silicon and glass composites with submicron viscoelastic interlayers and unconventional combinations of stiffness and damping", Compos. B Eng. 2024,111717 https://doi.org/10.1016/j.compositesb.2024.111717
- Patent pending

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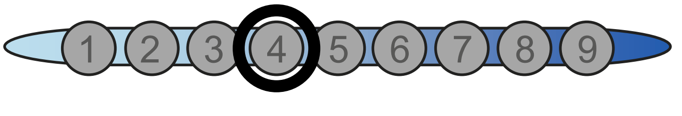
Technology Readiness Level



Background

Stiff materials are used in huge quantities. However, by their nature such materials are prone to the build-up of oscillations. This drawback manifests itself in vibrations and noise. Noise can be annoying and affect health. Moreover, vibrations are dreaded for reducing service life and even for catastrophic structural failure. To mitigate these deficiencies, the installation of external damping systems is widely employed, which may require extra energy and burden the structure with extra weight and volume.

Invention

Finite element calculations revealed that alternate layers of stiff and viscoelastic materials in certain thickness ratios exhibit unusual material properties: they suppress oscillations while the stiffness of the entire setup is determined by the stiff component itself. The unusual combination is retained in a broad frequency range due to the viscoelastic component. In other words: The antagonistic properties of stiffness and vibration damping are combined in a composite material. These predictions were substantiated by experiments with glass and silicon as the stiff components. The viscoelastic layer forms in a one-step chemical reaction between the stiff sheets. Polysiloxanes are suitable viscoelastic materials. They belong to a class of technically established polymers (applied e.g. as rubbers, sealants and medical implants). A prototype was made with a type of glass used for smartphone displays demonstrating effective mechanic and acoustic damping of the material.

Demonstration of comparative behavior on YouTube
https://youtu.be/X3ayDVgGsN8