Graphene Based High-performance Sound Absorbers

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Environmental noise has recognized impacts on human's psychological and physiological health including arterial hypertension, myocardial infarction, and stroke.[1] To mitigate noise pollution, different fibrous and porous acoustic absorbing materials were explored and commercially used which are often limited by low-absorption over a broad frequency range, delicacy, excessive weight and thickness, poor moisture insulation, high temperature instability.[2]

To address these limitations, we designed a new type of high-efficient absorbing material using graphene oxide (GO) self-assembled into a skeleton of melamine foam (Fig. 1). The fabricated lamella structure exhibits ≈60.3% enhancement over a broad absorption band between 128 and 4000 Hz (≈100% at lower frequencies) compared to the commercial melamine foam (MF) (Fig. 2a). This enhanced sound dissipation is explained by unique GO-lamella structures on melamine skeleton that provide air flow resistance, tortuosity against sound wave propagation and internal reflection (Fig. 2d. The acoustic absorption is found to be structure dependent regardless of the density. In addition, the prepared structures are mechanically robust, provides moisture/mist insulation and fire retardancy (Fig. 2b-c).[3] The fabrication of the new type of sound absorber is scalable and can be adapted for extensive applications in commercial, residential, and industrial building structures.

References

[1] M. Sørensen, et al, Environmental Health perspectives 121(2) 2013, 217-222.
[2] J.P. Arenas, M.J. Crocker, Sound & vibration 44 (7) (2010) 12-18.
[3] Md J. Nine, Md Ayub, A, C. Zander, D. N.H. Tran, B. S. Cazzolato, D. Losic, Advanced Functional Materials 2017, 27(46),1703820,

Figures

Figure 1: Fabrication of lamella structure. a-b) self-assembly process. c) Melamine foam (MF). d-e) Interconnected GO-into MF.

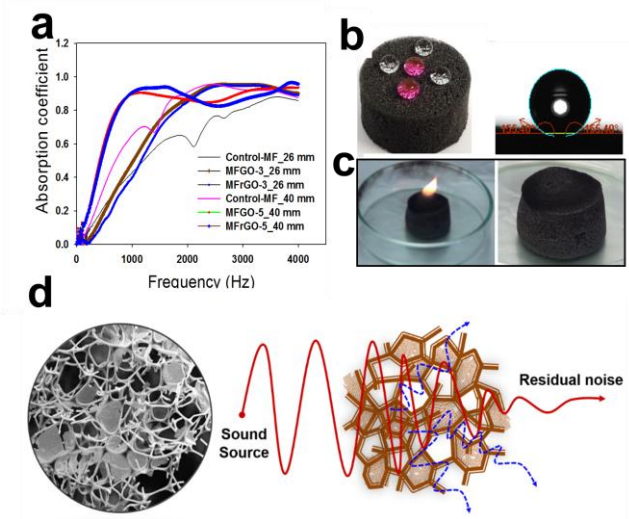

Figure 2: Sound absorption and other functional properties. a) Comparative sound absorption co-efficient. b) Super-hydrophobicity and moisture insulation. c) Fire-retardancy. d) Mechanism of enhanced sound absorption.