# Mechanical Energy Absorption of Metal-Organic Frameworks

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Development of energy absorption materials and structures are required for improved protection from damages and injuries associated with mechanical impact, vibration, or explosion. These can be seen in many fields such as vehicle crash safety, anti-blast body armour or armoured vehicles, vibration-proof precision equipment, earthquake-resistant building structures, and sports products such as helmets. The high surface area and porosity offered by metal–organic frameworks (MOFs) can be exploited to develop efficient energy absorption materials based on solid–liquid interactions or framework deformations under mechanical pressure [1]. In these processes, the energy absorption can be amplified by the internal surface area and porosity of MOFs and therefore holds great potential and has attracted increasing interest over the past decade. For example, the pressurised intrusion of non-wetting liquid into MOF nanopores can absorb mechanical energy and mitigate impact by generating a large solid–liquid interface [2,3].

This talk aims to give an overview of this emerging field to the community, highlighting its recent development and opportunities for MOF chemists. Starting with the concept of energy absorption and current energy absorption materials, we will introduce the idea of nanofluidic energy absorption and notable developments of it in the past two decades [1]. Then we will focus on the pressurised liquid intrusion of MOFs from quasi-static to highly dynamic regime [2] and discuss the latest development in our group including new experimental set-up that allow in-situ characterizations methods during high impact tests.

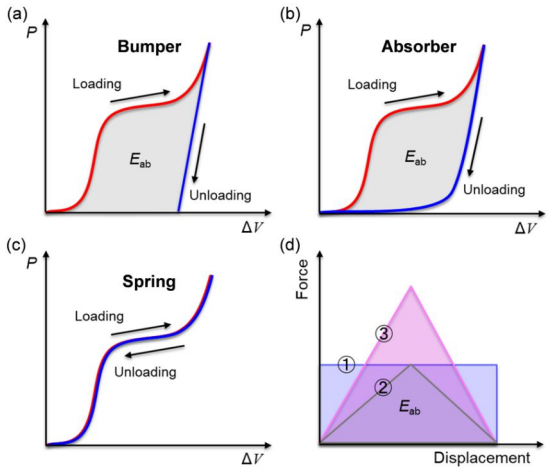


Figure 1: Typical mechanical behaviours of energy absorption materials that can be achieved by MOFs: (a) bumper, (b) absorber, and (c) spring, plotted as pressure–volume change (P–ΔV) with the energy absorption denoted as $E_{ab}$. (d) Three different cases of force–displacement relationship [1].

## References

[1] Y. Sun, H. Jiang. "Mechanical Energy Absorption of Metal–Organic Frameworks." Mechanical Behaviour of Metal–Organic Framework Materials. The Royal Society of Chemistry, **2023**. 267-338.

[2] Y. Sun, S. M. J. Rogge, A. Lamaire, S. Vandenbrande, J. Wieme, C. R. Siviour, V. Van Speybroeck and J.-C. Tan, *Nat. Mater.*, **2021**, 20, 1015.

[3] G Fraux, F.-X. Coudert, A. Boutin and A. H. Fuchs, *Chem. Soc. Rev.*, **2017**, 46, 7421.