# Hybrid Organic-Inorganic Perovskite (HOIP) based Glasses as Multifunctional Materials

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$ABX_3$ type hybrid organic-inorganic perovskites (HOIPs) are a new class of materials recently known for their barocaloric properties in crystalline phases.[1] I intend to broaden the international perception of HOIPs beyond barocalorics, explore their liquid and glass forming behaviour, and create a family of highly dense semiconducting materials for **thermoelectrics**.[2] In my previous position at Cambridge, I discovered the structural phase transforming ability of crystalline hybrid perovskite frameworks (e.g. $[TPrA][M(dca)_3]$, where TPrA = tetrapropylammounium cation; M = Mn, Fe, Co; dca = dicyanamide anion) to molten liquid at high-T ($T_m$ = ~ 250 °C) and then to glasses upon quenching to the low-T.[2,3] These are important given (i) they are only the second known family of hybrid glasses, i.e. those formed from connected inorganic and organic components, and (ii) they were found to exhibit lower thermal conductivities than traditional inorganic TE material families which involve high processing cost and possess environmentally unsuitable chemical components.

In this talk, I will provide an overview of my research, which aims to produce a new category of functional materials, based on $ABX_3$ type HOIP glass materials. In particular, I will present the fundamental synthesis and processing of these highly dense perovskite liquids and glasses, and show their mechanical, dynamical and thermomechanical properties and compare its cost-effectiveness and use with other organic polymeric, ceramic and elastomeric type materials. Physical properties in several key areas will be addressed for potential applications – for example, tuning electrical conductivities to increase **thermoelectric figure of merit**,[2] generating optical transparency to form a glass matrix to enhance **optoelectronic performance** for future generation **photovoltaics**[4].

## Reference

1. "Giant barocaloric effect in organic-inorganic hybrid $[TPrA][Mn(dca)_3]$ perovskite under accessible pressure" J. M. García et. al. ***Nature Communications***, 2017, 8, 15715 (1–8).
2. "Melting of hybrid organic–inorganic perovskites." **B K Shaw** et. al. ***Nature Chemistry***, 2021, 13, 778–785.
3. "Principles of melting in hybrid organic-inorganic perovskite and polymorphic $ABX_3$ structures." **B K Shaw** et. al. ***Chemical Science***, 2022, 13, 2033–2042.
4. "Liquid-phase sintering of lead halide perovskites and metal-organic framework glasses." J Hou et. al. ***Science***, 2021, 374, 621–625.