



Contribution ID: 55

Type: **Focus session invited talk**

Organic ionic plastic crystals with colossal barocaloric effects for sustainable refrigeration

Thursday 4 December 2025 14:10 (30 minutes)

Cooling technologies are essential for health and comfort worldwide, yet conventional vapour-compression systems are a major contributor to greenhouse gas emissions. These emissions arise from both the low energy efficiency of the cycle and the leakage of hydrofluorocarbon (HFC) refrigerants, which have very high global warming potentials. As demand for air-conditioning accelerates in a warming climate, emissions from both sources are set to rise sharply.

Solid-state refrigerants offer a promising route to eliminate the use of volatile greenhouse gases in cooling. In barocaloric materials, an order–disorder phase transition—and the associated thermal response—is driven by hydrostatic pressure, providing a solid-state alternative to liquid–vapour refrigerants.

Organic ionic plastic crystals (OIPCs) are a large but relatively underexplored class of organic salts that undergo one or more solid–solid phase transitions, producing a soft, dynamically disordered “plastic” phase before melting. Importantly for cooling applications, these thermal transitions often occur below room temperature.

Here we will report the barocaloric properties of four prototype BC-OIPCs using high-pressure differential thermal analysis, and the first measurement of the volume change across the phase transition using pycnometry. We will discuss our approach to decreasing the supercooling of the solid–solid phase transition, leading to a substantial enhancement in predicted barocaloric performance. These findings position OIPCs as a promising new class of material for next-generation, environmentally sustainable cooling technologies.

Author: Prof. PRINGLE, Jenny (Deakin University)

Co-authors: Prof. MACFARLANE, Douglas (Monash University); Dr KAR, Mega (Deakin University); Dr PIPER, Samantha (Deakin University)

Presenter: Prof. PRINGLE, Jenny (Deakin University)

Session Classification: Focus Session: Emerging Materials and Physics for Energy Conversion

Track Classification: Focus sessions: Emerging Materials and Physics for Energy Conversion