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**Multi-functional hydroxyapatite/polyvinyl alcohol composite aerogels
with self-cleaning, superior fire resistance and low thermal
conductivity**

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Abstract

Hybrid inorganic/polymer composite aerogels combine the advantages of both components which can overcome the brittle fracture of inorganic aerogels as well as high flammability of polymeric aerogels. Herein, we reported a facile approach to prepare polyvinyl alcohol (PVA)-hydroxyapatite (HAP) composite aerogel by freeze-casting process towards multi-functional aerogel materials. The incorporation of HAPs led to significant reduction in the peak heat release rate (-79%), total heat release (-76%), specific extinction area (-65%) and CO production (-45%). Vertical burning tests also manifested that PVA-HAP composite aerogels displayed excellent fire resistance and self-extinguishing behaviours. The resultant PVA-HAP composite aerogels also showed a low thermal conductivity (33.6–38.7 mW·m⁻¹·K⁻¹). The hydrogen bonding formed between the HAP and the PVA matrix endowed the

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