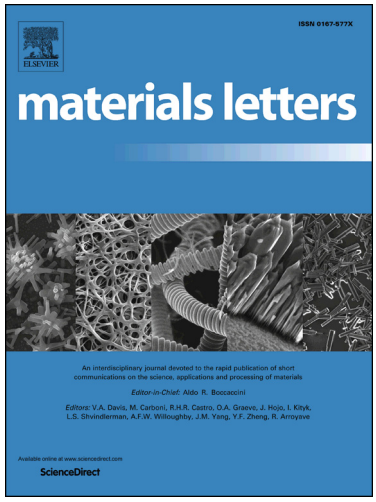

Ice-templated porous silicate cement with hierarchical porosity

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Ice-templated porous silicate cement with hierarchical porosity

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Abstract

Hierarchical porous silicate cements with lamellar/dendritic morphology were prepared by combination of ice-templating and hydration reaction routes. The macropores with multimodal pore distributions are found to be interconnected through intrinsic mesopores resulting from ice crystals growth and hydration products generation. As the slurry concentration increased from 40 to 60 wt%, the BET surface area decreased from 86.744 m^2g^{-1} to 70.707 m^2g^{-1}, the porosity decreased from 61.8% to 47.62%, whilst the compressive strength increased from 10.76 Mpa to 16.67 Mpa. Low-cost starting material and eco-friendly technique probably endow ordered porous cement with potential in a variety of applications including membrane separation and adsorption process.

***Keywords*:** Ice-templating; Porous materials; Cements; Hierarchical porosity; Microstructure; Low-cost

1. Introduction

Ice templating, also known as freeze casting, has been widely used to prepare novel porous materials with unique features [1, 2]. This facile process, where a material suspension is directly frozen and then sublimated before sintering or curing, provides materials with a special porous morphology, where the porosity is almost a direct replica of the frozen solvent crystals [3-5]. Freeze casted porous ceramics with excellent performances are gaining heightened attention in many fields, such as catalyst support, bioengineering, and filtration process [6-8]. The development and large-scale application of porous ceramics is hampered however by high material cost and complicated solidification technique.

Silicate cement, as a kind of high-performance and low-cost (~0.025 US dollars per kg) construction material, has been extensively utilized around the world [9]. Silicate cement not only has good work ability but also consolidates just by reacting with pure water (hydration reaction), which makes