Fast and Minimal-Solvent Production of Superinsulating Silica Aerogel Granulate

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Silica aerogel superinsulation products have a tremendous growth potential, mainly for industrial and pipe insulation. However, the high production cost prevent the adoption of silica aerogel products outside of their established niche markets. A one-pot synthesis for silica aerogel granulate is presented that significantly decreases solvent use, production time, and global warming potential. The inclusion of the hydrophobization agent prior to gelation with a postgelation activation step, enables a complete production cycle of less than four hours at the lab scale for a solvent use close to the theoretical minimum. The one-pot aerogel granulate retains the exceptional properties associated with silica aerogel, mostly the thermal conductivity of 14.4 $mW \cdot m^{-1} \cdot K^{-1}$ for the pilot scale materials, about half that of standing air (26 $mW \cdot m^{-1} \cdot K^{-1}$).

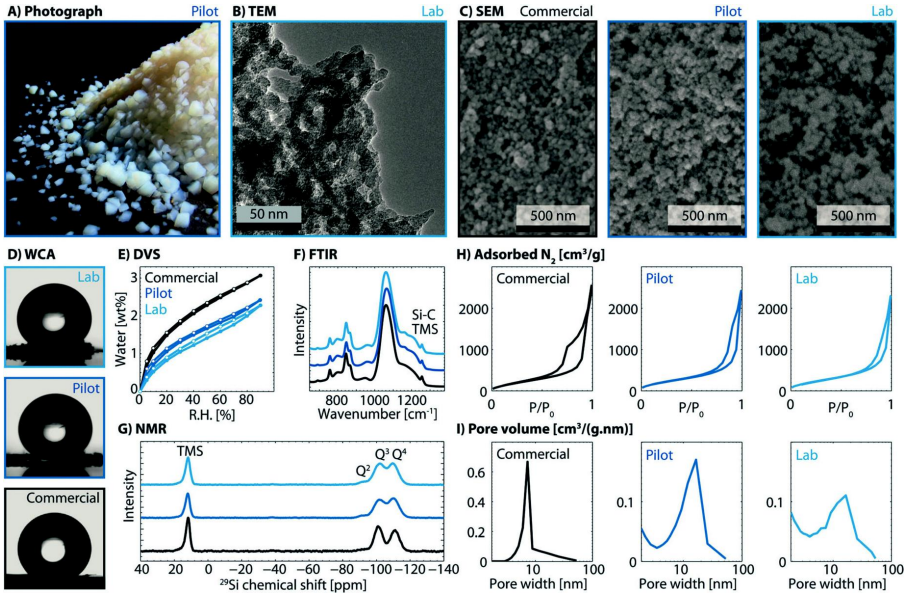

Figure 1. Structure, properties, and surface chemistry of one-pot and commercial aerogel. A) Photograph, B) TEM image, C) SEM images, D) water contact angle (WCA), E) dynamic vapor sorption (DVS), F) FTIR spectra, G) 1H–29Si CP MAS NMR spectra, H) nitrogen sorption isotherms, I) pore size distributions.

[1] Lukas Huber, Shanyu Zhao, Wim J. Malfait *et al., Angew. Chemie - Int. Ed.*, **2017**, 56, 1-5