Abstract Submitted
for the MAR09 Meeting of
The American Physical Society

Understanding the structure of porous materials created by freeze casting STEPHEN BARR, ERIK LUIJTEN, University of Illinois at Urbana-Champaign — When a suspension of colloidal particles in water freezes, dendrites of ice with high aspect ratios are formed which can either engulf or reject the particles based on their size and the velocity of the advancing ice front. As the particles are pushed between the dendrites, concentrated regions of colloidal particles are formed. Recent experiments have shown that this can be exploited to create strong, lightweight, porous materials. We investigate this process using molecular dynamics simulations, focusing on the effect of the ice front velocity on the structure of the resulting material. We develop a simulation model which accounts for particle engulfment or rejection by the dendrites. We study both columnar and lamellar geometries. Our main finding is that variation of the front velocity not only affects the particle concentration in the interdendritic regions, but also the degree of order of the resulting solid.

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Date submitted: 18 Nov 2008 Electronic form version 1.4