processes
Supplementary Materials

Design and Fabrication of Partially Foamed Grid Structure Using Additive Manufacturing and Solid State Foaming

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The diffusion coefficient and saturation concentration can be approximately estimated from the CO_2 concentration values experimentally measured as function of time, based on the following solution of diffusion equation [22];

$$\frac{C_t}{C_{sat}} = 1-\sum_{n=1}^{\infty}\frac{4}{\alpha_n^2 a^2}\exp(-D\alpha_n^2 t), \quad \text{(S1)}$$

where C is CO_2 concentration (the ratio between mass of CO_2, and copolymer filament measured), a is the radius of cylindrical rod, $J_o(x)$ is the Bessel function of the first kind of order zero, and α_ns are the eigenvalues, that is, the roots of $J_o(a\alpha_n)=0$. C_t and C_{sat} denote the concentration of diffusing substance (CO_2) entering the cylinder in time t and after infinite time, respectively.

Figure S1 shows the sorption behavior of CO_2 in the copolymer filaments at 10 MPa as function of time in order to confirm the partial sorption and degree of saturation. As expected, the CO_2 concentration steeply increased initially, and gradually converged to a saturation concentration. The measured data are well fitted to Equation (S1), and the estimated CO_2 uptake and charging diffusivity at −20°C are C_{sat} = 73.31 mg(CO_2)/g(copolymer) and D = 1.095 × 10^{-9} cm^2/s, respectively at the confidence level of 95%.

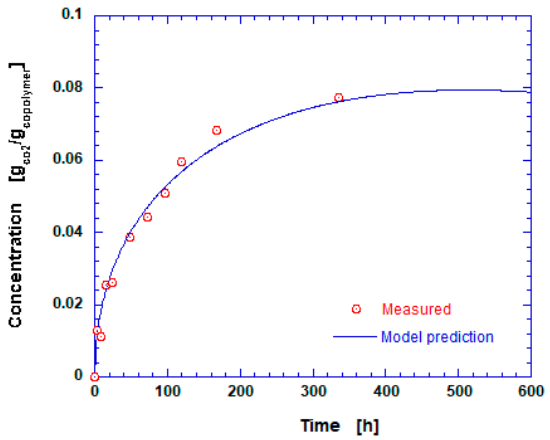

Figure S1 CO_2 Sorption kinetics in the copolymer considered.