

Supporting information

Nonisothermal crystallization

For nonisothermal crystallization kinetics, we used Seo's method reported in our previous works because Ozawa's approach is inappropriate for modeling nonisothermal crystallization. The rates of conversion to crystalline phase at various temperatures are compared in Ozawa's approach, but this approach can lead to substantial curvature in the Ozawa plots since the crystallization processes proceeding under different cooling rate will be at different stages.²⁰ By contrast, our approach can select the relative crystallinity at the same cooling rate and does not include values from other rates.²⁰ The validity of our approach has been established in our previous reports.²¹⁻²³ In the present work, we sought to elucidate the morphological changes that occurred during the foaming process as well as to obtain the Avrami constant value for cell density calculation.

The first column in the Figure S1 displays a linear variation of the maximum temperature of the terpolymer crystallization isotherm, T_{\max} , with the logarithm of the cooling rates ($\ln U$) for the samples. The predicted behavior is observed provided the cooling rate is low ($<7^{\circ}\text{C}/\text{min}$). T_{\max} decreases with increasing cooling rate because less time is available for crystallization at higher cooling rates. These findings show that our modified version of the Ozawa's theory is quite satisfactory.

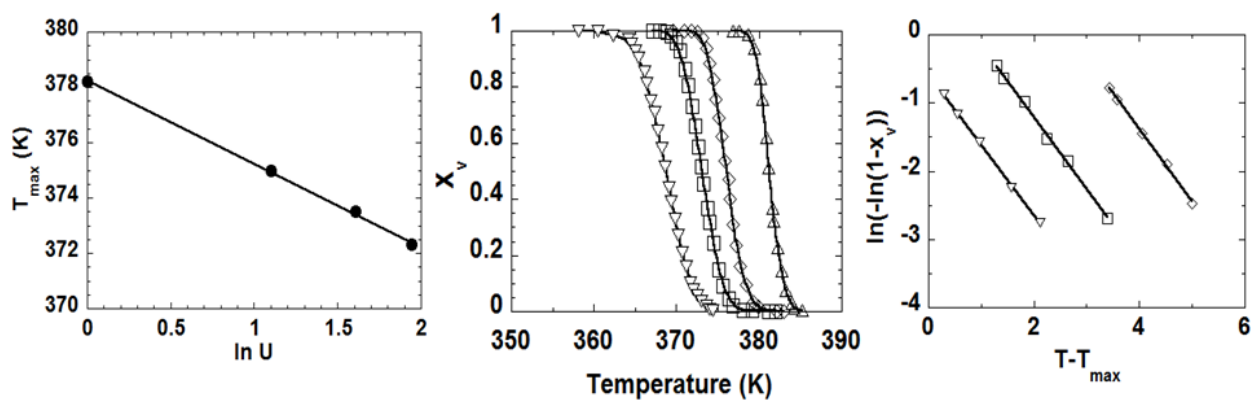
The second column in the Figure S1 displays the relative crystallinity of pristine terpolymer as a function of temperature for various cooling rates. The linear relationship between the cooling rates U and T_{\max} at higher cooling rates is observed as long as the cooling rate is low ($>7^{\circ}\text{C}/\text{min}$). T_{\max} decreases with increasing cooling rate because less time is available for crystallization at higher cooling rates. A large fraction of the relative crystallinity occurs after the most rapidly increasing point in the heat flow curve, where the kinetics begins to change to a

slower process.

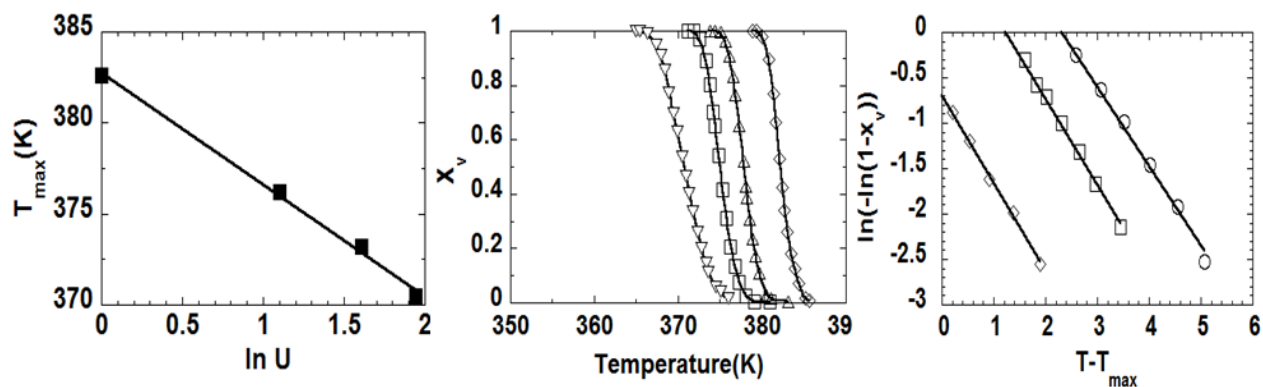
The plot of $\ln[-\ln(1-x_v(T)_U)]$ versus $(T - T_{\max})$, as shown in the third column in the Figure S1, gives a straight line with a slope of n/a . The calculated values of the Avrami exponent, n , are between 2.6 and 3.7, with an average value of 3.1 (Supplementary Table 1). This value is close to the characteristic value for spherulitic development arising from athermal instantaneous nucleation.¹⁴ These findings thus suggest that spherulites develop during nonisothermal crystallization of the terpolymer, because less time is available for crystallization at higher cooling rates, T_{\max} decreases as the cooling rate increases. T_{\max} of the foamed terpolymer is higher than that of the pristine terpolymer at the same cooling rate, indicating a faster crystallization for the foamed terpolymer. The observation of faster crystallization for the foamed terpolymer can be attributed to the existence of a greater density of nuclei in the foamed terpolymer than in the pristine terpolymer. The faster crystallization of the foamed terpolymer is due to its large number of nuclei of the exfoliated clay platelets, as shown later. The calculated average value of Avrami exponent, n , from Supplementary Figure 1 is *ca* 4.7 ± 0.3 for both unfoamed and foamed terpolymer (Supplementary Table 1). This large exponent implies a solid sheaf morphology.²³

Supplementary Figure 1

(a) Virgin terpolymer



(b) Foamed terpolymer containing 1wt% clay



Supplementary Table 1 Avrami exponent n calculated from the slope of Supplementary Figure 1.

Virgin terpolymer	Unfoamed nanocomposite including 1wt% clay	Foamed nanocomposite including 1wt% clay
3.1 ± 0.4	4.8 ± 0.3	4.7 ± 0.3

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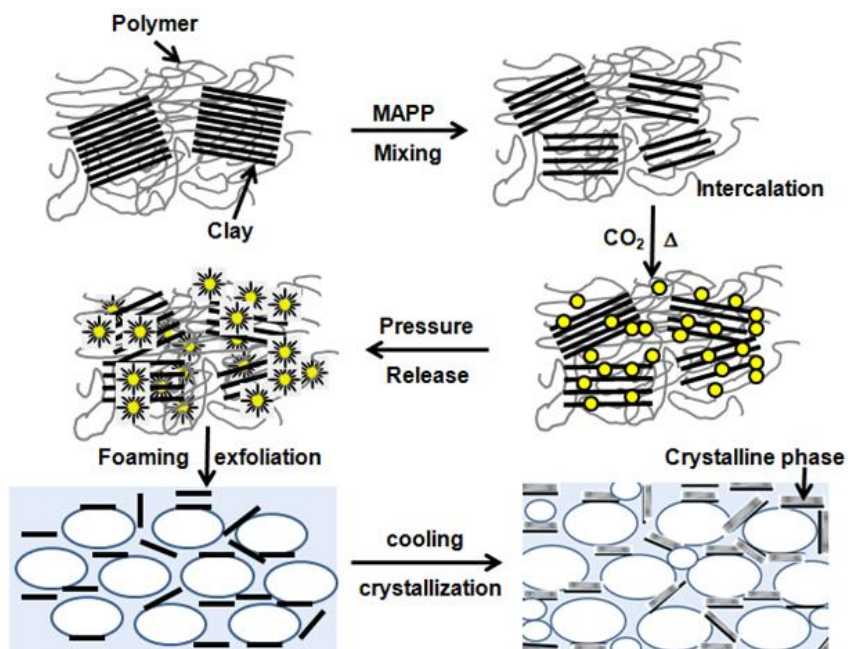


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