Modelling crystallization: When interfacial velocity depends on the expiring supersaturation

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The crystallization proceeds by the advancement of the crystal faces into the disordered phase with velocity r at the expense of the supersaturation Θ. It is not sustained in our model and changes from 1 in the beginning when $r = r_0$ to 0 at the end of the process. Using the kinetic law $r = r_0\Theta^g$, g is the growth order, we derive an equation for the rate of transformation $d\alpha/d\left(t/\tau\right) = 2D\alpha^{(D-1)/D}\left(1-\alpha\right)^g$ with time scale τ. It is integrated analytically for the six combinations of spatial dimension D and g=1,2 towards obtaining $\alpha_{Dg}\left(t/\tau_{Dg}\right)$. We verify our model by fitting $\alpha_{Dg}\left(t/\tau_{Dg}\right)$, D=2,3; with the Johnson-Mehl-Avrami-Kolmogorov model, $\alpha = 1-\exp\left[-\left(2t/\tau_{JMAKn}\right)^n\right]$, to obtain $\tau_{JMAKn} \approx 1.1\tau_{D1}$ and Avrami exponent n as 1.725, 2.5, respectively. Towards validation of our model, we develop a numerical protocol that is checked further using published experimental results and original data from Cellular Automata.