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Diffusion-Controlled Drug Release: Beyond Weibull

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Characterizing and predicting time release profiles is crucial in order to optimize the performance of drug devices. The exact analytical expression for the drug release function, which is a solution of the diffusion equation, is generally too complex to be employed for this purpose. Therefore, it is convenient to use simpler fitting functions which reproduce qualitatively the overall release profile. When the dominant release process is diffusion, the most used fitting function is a stretch exponential called Weibull function. Nevertheless, the Weibull function has a major drawback: it does not reproduce the short- and long-time behaviors imposed by diffusion theory. We propose a new fitting function, built from a semi-analytical approach, which reduces correctly to both limiting behaviors. Therefore, it allows to extract a crossover time between the transient and the stationary states which is crucial to characterize the release dynamic. Furthermore, thanks to Lattice Monte Carlo simulations, we show that our fitting function greatly outperforms the Weibull function and enables one to obtain the microscopic physical properties of the drug release system.

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