World Academy of Science, Engineering and Technology
International Journal of Chemical and Materials Engineering
Vol:15, No:11, 2021

Liesegang Phenomena: Experimental and Simulation Studies

Authors : Vemula Amalakrishna, S. Pushpavanam

Abstract : Change and motion characterize and persistently reshape the world around us, on scales from molecular to global. The subtle interplay between change (Reaction) and motion (Diffusion) gives rise to an astonishing intricate spatial or temporal pattern. These pattern formation in nature has been intellectually appealing for many scientists since antiquity. Periodic precipitation patterns, also known as Liesegang patterns (LP), are one of the stimulating examples of such self-assembling reaction-diffusion (RD) systems. LP formation has a great potential in micro and nanotechnology. So far, the research on LPs has been concentrated mostly on how these patterns are forming, retrieving information to build a universal mathematical model for them. Researchers have developed various theoretical models to comprehensively construct the geometrical diversity of LPs. To the best of our knowledge, simulation studies of LPs assume an arbitrary value of RD parameters to explain experimental observation qualitatively. In this work, existing models were studied to understand the mechanism behind this phenomenon and challenges pertaining to models were understood and explained. These models are not computationally effective due to the presence of discontinuous precipitation rate in RD equations. To overcome the computational challenges, smoothened Heaviside functions have been introduced, which downsizes the computational time as well. Experiments were performed using a conventional LP system ($AgNO_3$-$K_2Cr_2O_7$) to understand the effects of different gels and temperatures on formed LPs. The model is extended for real parameter values to compare the simulated results with experimental data for both 1-D (Cartesian test tubes) and 2-D(cylindrical and Petri dish).

Keywords : reaction-diffusion, spatio-temporal patterns, nucleation and growth, supersaturation
Conference Title : ICCCM 2021 : International Conference on Chemistry and Computational Materials
Conference Location : London, United Kingdom
Conference Dates : November 18-19, 2021