Research Inventy: International Journal of Engineering And Science
Issn (e): 2278-4721, Issn (p):2319-6483, PP: 37-38
www.researchinventy.com

Simulation Study of Stochastic Growth for Competitive Growth between Random Deposition and Random Deposition with Surface Relaxation in 2+1 Dimension

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Abstract:
The time evolution of rough surface is studied in terms of RMS fluctuation of height profile called the interface width $W(L,t)$. The dynamic growth regime is characterized by growth exponent β and the saturation regime is characterized by roughness exponent α. The different regimes of surface evolution are separated by critical time or cross-over time t_x. The overall evolution of the rough surface is best described by Family-Vicsek scaling ansatz as $W(L,t) \sim L^{\alpha} f(t/L^{z})$, where $z(=\alpha/\beta)$ is the dynamic exponent, $f(u) \sim u^{\beta}$ for $u \ll 1$ and $f(u) \sim constant$ for $u \gg 1$.

The rough surface developed through computer simulation for Competitive Growth between Random Deposition (RD) with probability p and Random Deposition with Surface Relaxation (RDSR) with probability $1-p$, on a square plane $(L \times L)$ for system size L (16, 32, 64, 128, and 256) to record the statistical average of time variation of surface roughness $W(L,t)$ & average height $H(t)$ for the model for different sets of values of L and p. Estimated the scaling exponents from this data.

Except for pure RD for $p = 1$, the evolution appeared with two regimes of time growth with two acutely different slopes, β_1 and β_2, and saturation regime with roughness α. Both the growth exponents β_1 and β_2 are independent of L but have some dependence on p. For saturation regime, $W(L,t)$ has some dependence on p. The roughness exponent α is almost independent of p. The first critical time t_x is independent of L and has some dependence on p. The second critical time t_{sat} shows some dependence on both L and p. The scaling exponents are found to have some deviation from the relevant universality classes and dependence on system size for this model.

Keywords: ***competitive growth model, random deposition, surface relaxation, scaling exponents, growth exponent, roughness exponent, dynamic exponent, cross-over time, critical time.***