

Multiparticle biased diffusion-limited aggregation with surface diffusion: A comprehensive model of electrodeposition

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Abstract-

We present a complete study of the multiparticle biased diffusion-limited aggregation (MBDLA) model supplemented with surface diffusion (SD), focusing on the relevance and effects of the latter transport mechanism. By comparing different algorithms, we show that MBDLA + SD is a very good qualitative model for electrodeposition in essentially the whole range of current intensities provided one introduces SD in the model in the proper fashion. We have found that the correct procedure involves simultaneous bulk diffusion and SD, introducing a time scale arising from the ratio of the rates of the two processes. We discuss in detail the different morphologies obtained and compare them to the available experimental data with very satisfactory results. We also characterize the aggregates thus obtained by means of the dynamic scaling exponents of the interface height, allowing us to distinguish several regimes in the mentioned interface growth. Our asymptotic scaling exponents are again in good agreement with recent experiments. We conclude by discussing a global picture of the influence and consequences of SD in electrodeposition.

Index Terms- thin-layer electrodeposition, monte-carlo simulation, electrochemical deposition, morphological evolution, fractal dimension, pattern-formation, dendr

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