# EFFECTS OF LATERAL DIFFUSION ON ADSORBATE MORPHOLOGY AND DYNAMICS IN A LATTICE-GAS MODEL OF METAL ELECTRODEPOSITION

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## Introduction

"Avrami's law" is a simple approximation that gives the time evolution of a phase transformation with astonishing accuracy in many systems, ranging from food science to astrophysics. However, little is known about how to generalize it in systems in which the constituents diffuse laterally on the substrate during the transformation. In this work we use kinetic Monte Carlo simulations to study the effects of lateral diffusion on the time development and structure in a lattice-gas model of pulsed electrochemical deposition of metal on metal. Such deposition processes are widely used in industry for applications ranging from chrome-plating of car bumpers to deposition of copper interconnects in integrated circuits.

## Results and Discussion

We find that lateral diffusion has two main effects. Most immediately visible is a coarsening of the adsorbate structure. This effect is shown in Fig. 1. The second important effect, which we studied by recording the size distributions of the adsorbate clusters, is a depletion of medium-sized clusters, compared to the diffusion-free case.

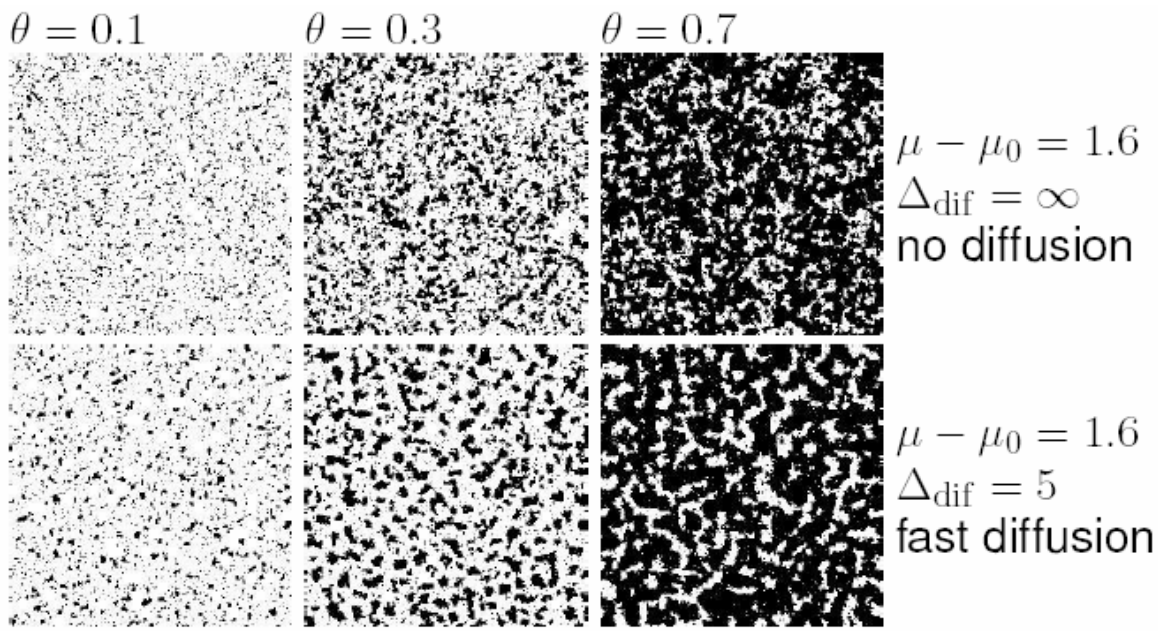


**Figure 1.** Time evolution of the adsorbate structure during adsorption at a fixed electrochemical overpotential, $\mu-\mu_0$. $\theta$ is the adsorbate coverage (number of adsorbate particles per adsorption site), and $\Delta_{\rm dif}$ is the free-energy barrier for lateral diffusion. A low barrier corresponds to diffusion that is fast, corresponding to the adsorption/desorption process, while a high barrier corresponds to slow diffusion.

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## References

[1] S. Frank, *et al.*, J. Chem. Phys., **122**, 064705 (2005).