

Plasma polymer fragments deposited from vapor on non-wetting polymer substrates are seen to aggregate into fractal nanoislands. Dependent on conditions of the experiment, the islands attain diverse shapes ranging from dendritic snowflakes, branching seaweed to twisting snakes. In our work, we identify dominant kinetic processes responsible for this diversity and relate them to physical characteristics of the experiment.

We review and implement basic computer models of deposition and aggregation of diffusing particles: The Diffusion-Limited Aggregation (DLA), both on a lattice and without a lattice, and the Cluster-Cluster Aggregation (CCA). The off-lattice DLA yields isotropic random fractals. The lattice DLA fractals are influenced by the properties of the lattice itself, which can be chosen to represent the symmetry of the substrate layer on which the islands grow. Fractals generated in the CCA model are more linear. Competition between diffusion and deposition rates gives a transition between off-lattice DLA and CCA fractals.

Each of these models comprises a mechanism that we conjecture to be dominant during growth of distinct observed polyethylene nanoislands. Thus the multiple observed fractal shapes allow us to draw conclusions on microscopic kinetics of the surface diffusion of deposited polymer fragments. The gained insight into the kinetics may be relevant for plasma-assisted development of polymer-based devices.