Randomly Patchy Surfaces

- appear commonly in nature (minerals, bacteria cells)
- involve a broad distribution of length scales, functionalities
- heterogeneities (and non-average surface characteristics) can dominate adhesive behavior

Random Surface Heterogeneities Can be Engineered to

- bind target particles with sharp selectivity
- separate mixtures of particles
- manipulate the dynamic adhesion of target particles
- direct adhesive particle motion (rolling, skipping, arrest, sliding)
- maintain sustained particle rolling in flow on microfluidic elements

Localization of Attractions

Small "receptors" Glycocalyx "field"
Using Randomly Heterogeneous Surfaces for Selective Particle Capture

(without use of biomolecular fragments such as antibodies, DNA)

Here a mixture of microspheres is flowed over a heterogeneous surface containing a specific amount of cationic nanoparticles. A control surface adheres all the microparticles while the engineered surface adheres only the targeted population.

More sharply curved particles captured with nearly perfect specificity
Using Randomly Heterogeneous Surfaces for Control of Dynamic Particle Adhesion and Rolling

Leukocytes: L-selectin vs Silica Particles: Cationic Patches

Here, at very specific engineered surface conditions microparticles and bacteria roll on electrostatically heterogeneous surfaces, but do not arrest or escape.

Read More:

Using Heterogeneities for Selective Particle Adhesion:

Mechanisms of Interaction at Heterogeneous Interfaces:

Flow Effects on Heterogeneity-Mediated Adhesion:

Heterogeneities in BioAdhesion and Biomaterial Design: