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Gene brushes on a chip: From crowding and the search problem to synthetic systems

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We assemble DNA polymer brushes coding for entire genes on a surface by means of a new photolithographic approach. The gene density can be controlled from dilute to high density where the local concentration – Megabase pairs per micron cubed – is comparable to that in a bacterium. The gene brush, therefore, emulates the crowded medium of the cell, allowing us to study DNA transactions in vitro under native conditions. We find that transcription/translation from these gene brushes is highly sensitive to DNA density, orientation and composition. As a step towards multi-gene synthetic systems, we integrated on a chip two spatially separated gene brushes, and implemented a two-stage transcription/translation cascade.