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The Wolfson Department of Chemical Engineering

Wolfson Department of Chemical Engineering Seminar
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Autonomous synthesis and assembly of a ribosomal subunit on a chip

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Ribosome biogenesis is an efficient and complex assembly process that has not been reconstructed outside a living cell so far, yet is a critical step for establishing a self-replicating artificial cell.

We developed a platform to reproduce the autonomous synthesis and assembly of a ribosomal subunit from synthetic genes immobilized on the surface of a chip. The genes were spatially organized in the form of dense DNA brushes in contact with a macroscopic reservoir of cell-free minimal gene expression system. We showed that the transcription-translation machinery actively self-organized on DNA brushes, forming local and quasi-2D sources for nascent RNA and proteins.

We recreated the biogenesis of Escherichia coli's small ribosomal subunit by synthesizing and capturing all its ribosomal proteins and RNA on the chip. Surface confinement provided favorable conditions for autonomous step-wise assembly of new subunits, spatially segregated from original intact ribosomes. Our real-time fluorescence measurements revealed hierarchal assembly, cooperative interactions, unstable intermediates, and specific binding to large ribosomal subunits.

Using only synthetic genes, our methodology is a crucial step towards creation of an autonomous self- replicating artificial cell.