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A Single–Step Photolithographic Interface for Cell-Free Gene Circuits and Active Biochips AMNON BUXBOIM, MAYA BAR-DAGAN, VERONICA FRYDMAN, DAVID ZBAIDA, MARGHERITA MORPURGO, ROY BAR-ZIV, Weizmann Institute of Science — We developed a biochip platform technology suitable for controlled cell-free gene expression at the micron scale. A new hybrid molecule, "daisy," was designed and synthesized to form in a single step a bio-compatible lithographic interface on silicon dioxide. A protocol was formulated for immobilization of linear DNA molecules thousands of base pairs long on daisy-coated surfaces to submicron spatial resolution and up to high densities. On-chip protein synthesis can be obtained with dynamic range of up to four orders of magnitude and minimal nonspecific activity. En route to on-chip artificial gene circuits, a simple two-stage gene cascade was built in which the protein synthesized at the first location diffuses to regulate the synthesis of another protein at a second location. The current approach opens possibilities for laboratories not proficient in surface chemistry to design active biochips based on cell-free gene expression with applications in artificial systems and synthetic biology.

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