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Nanofluidic laboratory-on-chip device for mapping of single molecule DNA extracted from single cells SARA MAHSHID, DANIEL BERARD, Dept of Physics, McGill University, ROBERT SLADEK, McGill Genome Innovation Center, SABRINA LESLIE, Dept of Physics, McGill University, WALTER REISNER, Dept of Physics, McGill — The aim of this project is to create a nanofluidic platform to provide comprehensive maps of single-cell genomes at 1 kbp resolution based on the direct analysis of single 1-10 Mbp extended DNA molecules extracted from individual cells on-chip. We have developed a nanodevice in which all biochemical processing of single cells (cell lysis, DNA purification and fragmentation) is performed in situ. The platform has the following three components: (1) a microcavity (50×20 micron in dimension) for trapping and biochemical processing of single cells; (2) post arrays (1 micron depth) for untangling the released genomic contents and (3) parallel nanochannel arrays (100 nm) for extension of $\sim$ 1-10 Mbp DNA for high-throughput optical mapping. Moreover, we use "Convex Lense-Induced Nanoconfinement" (CLIC) technique for trapping of single cell and dragging DNA into nanochannels. The principle is that a convex lens is pushed down to deform a flexible coverslip lid above the aforesaid platform containing nano/micro patterns, creating a locally confined region that pins molecules in the embedded nano/micro features. CLIC is used to lower the device lid over a cell isolated in the microcavity with an adjustable gap for buffer exchange. The released DNA is untangled using 1 micron-deep post arrays and driven into nanochannel array where its genomic content is revealed. In particular, using CLIC we were able to successfully trap 20 micron lymphoblast cells inside microcavity and lyse the trapped cell to drive out DNA.

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