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DNA Analysis in Nanochannels for Bacterial Identification

The DNA (Deoxyribonucleic acid) is a molecule found in every living organism and bears information which is unique for its carrier. Reading this information would thus allow to identify any kind of organism. The existing methods to read the content of the DNA are most of the times either slow or expensive. In this project, a novel technique to visualize the information stored in the DNA is explored. This technique has the potential to simplify and speed up the reading process, making it suitable for the identification of bacteria and thus making it a powerful diagnostic tool.

The basic principle of the technique is illustrated in the figure below. A DNA molecule is inserted into tiny channels (nanochannels) that force the molecule to stretch out. The DNA is then labelled with a special dye that falls off at specific regions of the DNA upon heating. These regions depend on the information of the DNA. Under the microscope, only regions containing the dye are visible. This pattern of bright and dark regions along the DNA can be interpreted as a barcode, which is unique for every organism. By comparing this barcode with a database of theoretically generated barcodes, the DNA and its carrier can be identified.

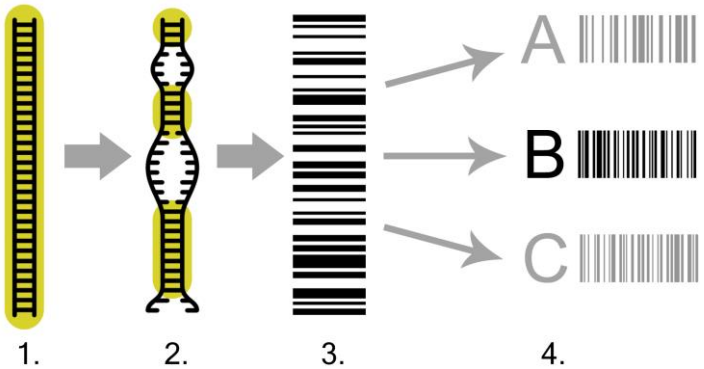

Illustration of the analysis of a DNA molecule in nanochannels and its identification.

In this project, fundamental studies of the technique have been performed and an attempt at identifying bacteria was made. It could be shown that it takes 10 minutes for the barcode to appear on the DNA when heated. It was also observed that the temperature at which the barcode appears depends on the amount of dye and the level of confinement of the DNA. Further, a good agreement between experimental barcodes and theoretical barcodes could be demonstrated. Even though a large amount of bacterial DNA was analysed, an identification of the bacteria could not be realized yet. Improvements in the experimental method as well as in the data analysis are believed to improve the results.

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