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Controlled engulfing and ejection of a microbead into and out of a microdroplet

Fast, accurate and cheap synthesis of ultralong strands of DNA is an essential foundation for synthetic DNA technologies such as cellular programming and engineering. However, the high cost of oligonucleotide production necessitates advanced and cost-efficient techniques for genome synthesis. Current methods also utilize microbeads for genome assembly that result in unwanted byproducts and limited control of reagent contact. To circumvent these limitations, the Hesselink lab at Stanford invented a method that allows for the control of a single bead during assembly.

The inventors demonstrate the viability of controlled encapsulation and ejection of a single microbead into and out of a water microdroplet. The device integrates a microfluidic droplet generator with a suitably designed and aligned Indium Tin Oxide electrode structure to successfully manipulate microbeads within a microdroplet. This device generates a single water microdroplet on demand which then is electrically manipulated onto an electrode to engulf an already trapped bead on the electrode. The bead being hydrophobic ejects out of the device once the voltage supply to the electrode is switched off. This invention is the first method to overcome the surface tension barrier of a microdroplet to controllably engulf a microbead completely inside a microdroplet and then eject it out of the droplet using electric forces. The device can be used to significantly lower reagent consumption and improve the synthesis of long nucleotide sequences.

Applications

- 1. On-chip solid phase DNA synthesis on individual solid supports.
- 2. DNA data storage.

- 3. Solid phase peptide synthesis.
- 4. Any solid phase synthesis in general

Advantages

- 1. Significantly lower cost
- 2. Significantly lower reagent consumption and wastage.
- 3. Improved reaction efficiency leading to the synthesis of longer strands of DNA

Patents

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Innovators

- Lambertus Hesselink
- Punnag Padhy
- Mohammad Asif Zaman
- Ronald Davis
- Michael Jensen

Licensing Contact

David Mallin

Licensing Manager, Physical Sciences

Email