Carbon nanofiber electrodes for use in lateral flow assays

Lateral flow assays (LFAs) are immunochromatographic rapid tests in strip format that are fast and easy-to-use without a need for specialized staff or expensive equipment. These portable devices detect target substances in a liquid sample via colorimetry and are based on an antigen-antibody reaction. Electrochemical systems, on the other hand, use electrodes and enable a more sensitive and quantitative measurement compared to colorimetric detection.

IP RIGHTS
Ongoing in US and granted in DE, FR, GB
2024

Combining electrochemistry and the principle of flow assays

In conventional electrochemical systems, electrodes are only integrated on the surface of the test resulting in 90% of the analyte flowing past undetected. Our invention combines the advantages of conventional LFAs and electrochemical systems by integrating porous 3D electrode mats which the analyte flows through.

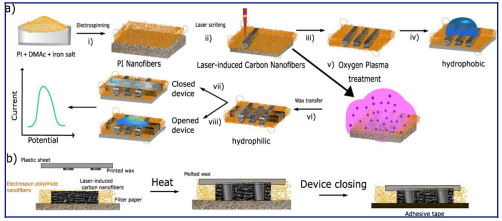
Perju et al., 2022, Microchimica acta

01 Higher sensitivity and more quantitative measurement compared to conventional LFAs

02 Easy on-site analysis for consumers at home is maintained

03 Unchallenging integration into current production processes

04 Microfluidic systems planned: Direct flow through microchannels in electrode due to inherent capillarity



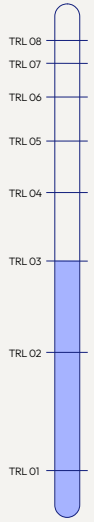
a) Electrospinning of polyimide solution into precursor nanofibers collected on an oxygen plasma treated filter paper and subsequent carbonizing. b) Transferring printed wax onto the electrospun polyimide carried nanofiber substrate.

CHALLENGE

In conventional LFAs, colorimetric detection by eye or camera only allows for semi-quantitative results. More advanced readout devices can measure reflectometrically or fluorescently but are very expensive. This defeats the purpose of a cheap test for a quick and easy use at home for consumers. There are currently no electrodes that can be integrated in a flow system and allow for electrochemical measurements in a 3D electrode network in conventionasl LFAs.

INNOVATION

The invention describes printable freestanding laser-induced carbon nanofibers (LCNF) with outstanding analytical performance that can easily allow such miniaturization through a paper-based microfluidic strategy. 3D-carbon nanomaterials have proven to be high-performance transducers in electrochemical sensors. The LCNF electrodes were generated from electrospun polyimide nanofibers and one-step laser carbonization. Integration into closed microfluidic systems highlights that 3D porous structures provide excellent analytical performance and translation to affordable lab-on-a-chip devices such as LFAs.



01 Basic principles observed · **02** Technology concept formulated · **03** Experimental proof of concept · **04** Technology validated in lab · **05** Technology validated in relevant environment · **06** Technology demonstrated in relevant environment · **07** System prototype demonstrated in operational environment · **08** System complete and qualified

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