Fabrication of Carbon Micro Electrodes by Local Laser Pyrolysis

Ludvigsen, Emil; Pedersen, Nina Ritter; Zhu, Xiaolong; Marie, Rodolphe; Mackenzie, David; Petersen, Dirch Hjorth; Kristensen, Anders; Emnéus, Jenny; Keller, Stephan Sylvest

Publication date: 2019

Document Version
Publisher's PDF, also known as Version of record

Link back to DTU Orbit

Citation (APA):
Fabrication of Carbon Micro Electrodes by Local Laser Pyrolysis

Emil Ludvigsen1, Nina Ritter Pedersen1, Xiaolong Zhu2, Rodolphe Marie2, David M.A. Mackenzie3, Dirch H. Petersen1, Anders Kristensen2, Jenny Ennénus4, Stephan Sylvest Keller1

1National Centre for Nano Fabrication and Characterisation, DTU Nanolab, Technical University of Denmark, Lyngby, 2800 Denmark
2Department of Physics, DTU Nanolab, Technical University of Denmark, Lyngby, 2800 Denmark
3Department of Biomedical Engineering, DTU Bioengineering, Technical University of Denmark, Lyngby, 2800 Denmark
4emilu@dtu.dk

Motivation and Aim

Local laser pyrolysis (LLP) has previously been demonstrated as a method for writing carbon micro-electrodes in polyimide, to make flexible electronics and micro super-capacitors [1-3].

The aim of this study was i) To demonstrate LLP of absorber-modified SU-8. ii) To gain knowledge of the LLP process as a gateway to pyrolyse other polymers via direct laser writing.

Process overview of laser pyrolysis

SU-8, modified to absorb light at 800 nm wavelength, is spin coated onto a boron glass wafer. A collimated laser beam with a very narrow peak intensity at 806 nm is then used for locally pyrolysing the SU-8, essentially enabling direct writing of conductive carbon micro electrodes.

Fig 1. Overview of the laser pyrolysis process of absorber-modified SU-8. a) SU-8 mixed with the absorber, Pro-Jet 800NP (FujiFilm), is spin-coated onto a boron glass wafer. b) A laser, operating at 806 nm, is used to locally pyrolyse the SU-8 under a nitrogen atmosphere. c) Electrical evaluation of the written line

Laser-written, pyrolysed structures

Various conducting, laser written structures. As can be seen, laser writing allows for very high design flexibility, but requires that the substrate can absorb the light.

Electrical measurements

Electrical measurements on the written lines and structures. The degree of carbonization, evaluated through a resistivity measurement, can be seen to follow a declining power series with increasing laser power. The resistance is directly proportional to the path length but independent of the number of nodes and intersects on its way, confirming the seamless joining of lines.

Conclusion

We have demonstrated localized laser pyrolysis by direct laser writing in absorber-modified SU-8. The SU-8 will not interact with the laser unless the absorber is added. The design flexibility is very high and lines can be joined together without added resistance. The highest, estimated conductance achieved is 2.26 ± 0.27 S/cm.

References

2. S. Liu, P. T. Yang, L. T. Tsai, Carbon 98 (2015) 121-126

The authors would like to acknowledge the European Research Council for funding the project (PHD2010).

Presenting author

Emil Ludvigsen
Ph.D. Student
DTU Nanolab
emilu@dtu.dk