



LASER-INDUCED STABILIZATION AND CARBONIZATION OF PAN FIBROUS WEB

Task

Nowadays, carbon nano-fibrous web is almost exclusively produced by further processing electro- or rotation-spun PAN solutions. To manufacture carbon fibrous web, the industry conventionally stabilizes PAN fibrous web in time- and energy-consuming oven processes, first at 200–400 °C for approx. two hours in air, and then carbonizes them under inert gas for approx. 30 minutes at temperatures around 1300 °C. Melt-spun fibrous web, which should be preferred to avoid the use of solvents, cannot currently be stabilized and carbonized by means of furnace processes.

Method

In cooperation with the project partners Leibniz Institute for Interactive Materials DWI and Fraunhofer Institute for Applied Polymer Research IAP, Fraunhofer ILT is developing a laser-based process that can be used to stabilize and carbonize rotationally spun fibrous web. In addition, the partners are chemically modifying the PAN solutions so that they can be processed in a melt spinning process and stabilized and carbonized by means of laser-based processes. Furthermore, the laser-based carbonization process is expected to produce fibrous webs with graded porosity and specific surfaces in the range of several 100 m²/g.

Results

The fibrous web can currently be stabilized and carbonized, in subprocesses, both with continuously emitting and pulsed laser beam sources, depending on the chemical modifications of the fibrous webs. The fibers are not melted, thus preserving the fiber structure. The irradiation time for the stabilization of 2.5 cm² fibrous web is currently approx. 20 s and the irradiation time for carbonization approx. 40 ms. Future research will work on reducing the times for stabilization further and on adjusting of the fiber porosity.

Applications

The carbonized, highly porous fibrous webs are used as electrode material in high-performance electronic components (supercapacitors, batteries, fuel cells), in filter media (hot gas filtration, regenerable HEPA filters) and in adsorbents (body odor neutralization).

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Contact

Dipl.-Phys. Carsten Johnigk
Telephone +49 241 8906-672
carsten.johnigk@ilt.fraunhofer.de

Dr. Christian Vedder
Telephone +49 241 8906-378
christian.vedder@ilt.fraunhofer.de

2 SEM image of a laser-stabilized PAN fibrous web, © DWI.