ELECTROSPUN NANOFIBRES AS REINFORCING AGENT IN RUBBER MATRICES

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An interesting area of modern material sciences deals with the manufacture of structured nanometer-scale materials. Nanofibers with diameters two orders of magnitude below those of conventional industrial fibers have a high potential in various applications such as scaffolds in medical technology, efficient nano-filters and catalyst carriers and, last but not least, as reinforcing agent [1].
Such nanofibers can be produced by the electrospinning process from a large number of polymeric precursors. The electrospinning process makes use of electrostatic forces to stretch a polymer solution before it solidifies. There are different parameters which have an effect on the fiber morphology and diameter such as solution parameters like viscosity, conductivity or surface tension and process parameters like applied voltage and tip-to-collector distance [2].
An electrospun nanofiber web has a high surface to volume ratio, thus a large interphase for polymer-fiber interactions can be achieved to get improved mechanical performance of the composite material. Therefore the fiber dispersion in the polymer matrix limits the reinforcing effect. Parameters like aggregation behavior of the reinforcing fibers, rheological properties of the polymer matrix and processing technology have a direct influence on the fiber dispersion.

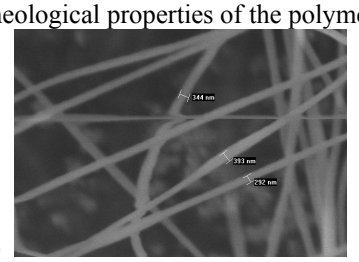
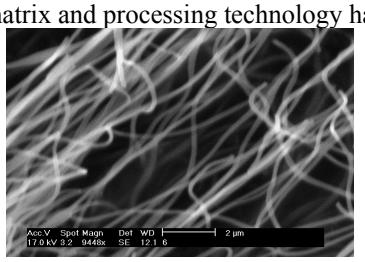
a)  b) 

Figure 1. SEM picture of electrospun polyacrylonitrile fibers (a) and carbonized fibers (b)

Polyacrylonitrile fibers as well as carbonized fibers were incorporated into a nitrile butadiene rubber (NBR) with different techniques. On the one hand the fibers were mixed into the rubber on a mill and on the other hand sandwich-like structures were built up. The obtained composite materials were characterized by tensile and dynamic mechanical tests as well as microscopic methods (AFM, TEM) to characterize the fiber dispersion and the anisotropy of the material. The results were compared with carbon black and carbon nanotube filled material.

Acknowledgements
These studies have been supported by Deutsche Kautschuk-Gesellschaft (DKG).

References
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2. S. Ramakrishna, K. Fujihara, W. E. Teo; An Introduction to Electrospinning and Nanofibres, World Scientific, Singapore, 2005

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am DIK seit 10/2006

- Herstellung und Charakterisierung von Fasern durch Elektrospinning (FT- IR, REM, Viskosimetrie)
- Fasern als Gerüstsubstanz für artifizielle Gewebe
- Elastomerbauteile mit adaptiven Eigenschaften
- Verstärkung von Mikrobauteilen durch Elektrospinning