Carbon 2006, Aberdeen, UK

Mechanical properties of pyrolytic carbon analyzed by nanoindentation and atomic force microscopy

A. Pfrang[1], M. Müller[1], C. Ziebert[2], S. Ulrich[2], Th. Schimmel[1, 3]

[1] Institute of Applied Physics, University of Karlsruhe, D-76128 Karlsruhe, Germany

[2] Institute for Materials Research I, Forschungszentrum Karlsruhe, D-76021 Karlsruhe, Germany

[3] Institute of Nanotechnology, Forschungszentrum Karlsruhe, D-76021 Karlsruhe, Germany

Session "Physical and Chemical Properties"

227 < 250 words

The microscopic mechanical properties of the pyrolytic carbon matrix in carbon/carbon composites play an important role for the overall macroscopic mechanical properties of the composite.

Nanoindentation is well suited for the characterization of mechanical properties of carbon materials [1]. Here, this technique was applied on pyrolytic carbon matrices with different textures. A clear dependence of reduced Young's modulus and hardness on the degree of texture was observed by nanoindentation linescans on polished cross-sections.

Additionally, force modulated atomic force microscopy (AFM) was applied for the characterization of elastic properties. This method allows the determination of contact stiffness on the nanometer scale. First results on carbon/carbon composites show not only different contact stiffness values for differently textured pyrolytic carbon layers but also that the method allows the local, microscopic characterization of the degree of anisotropy of the mechanical properties [2]. Finally, the discrimination of two different types of carbon fibers in a composite was be achieved on the basis of a microscopic analysis of their mechanical properties.

[1] C. Ziebert, C. Bauer, M. Stüber, S. Ulrich, H. Holleck, Characterisation of the interface region in stepwise bias-graded layers of DLC films by a high-resolution depth profiling method, Thin Solid Films 482, 63-68 (2005).

[2] A. Pfrang. Von den Frühstadien der Pyrokohlenstoffabscheidung bis zum Kompositwerkstoff - Untersuchungen mit Rastersondenverfahren. PhD thesis, University of Karlsruhe, Verlag Dr. Hut, München (2005), ISBN 3-89963-133-1.