Registration for the Spring-Meeting of the
German Physical Society
from 27.03. to 31.03.2006
in dresden

Calculation of the Evolution of Surface Area and Free Volume During the Infiltration of Fiber Felts — •Andreas Pfrang[1], Katja Schladitz[2], Andreas Wiegmann[2], and Thomas Schimmel[1,3] — [1]Institute of Applied Physics, University of Karlsruhe, D-76128 Karlsruhe, Germany — [2]Fraunhofer Institut für Techno- und Wirtschaftsmathematik, D-67653 Kaiserslautern, Germany — [3]Institute of Nanotechnology, Forschungszentrum Karlsruhe, D-76021 Karlsruhe, Germany

Carbon-carbon composites offer a unique combination of excellent mechanical properties, high thermal stability and low mass density. For the chemical vapor infiltration of pyrolytic carbon the ratio of surface area to free volume A/V plays a crucial role in understanding and modeling the deposition process. Here, the evolution of surface area and free volume during the infiltration of fiber felts was calculated quantitatively, using both an analytical approach and numerical calculations.

A/V was obtained analytically with a Boolean model using the approximation of overlapping fibers. For this model, we find that A/V increases linearly with the radius of the fibers. The model also allows to estimate surface area and free volume for felts with non-overlapping fibers for low initial filling factors.

In addition, numerical calculations of the evolution of A/V were performed. Models of felts with randomly distributed, non-overlapping fibers with different degrees of orientation anisotropy, including parallel fibers and isotropic orientation of the fibers, were generated. It is shown that A/V increases nearly linearly.

Location:	dresden
Date:	27.03.—31.03.2006
Section:	Thin Films
Subject:	Layer deposition: CVD
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