Technische Universität Hamburg-Harburg

TUHH Ceramics

INSTITUT FÜR KERAMISCHE HOCHLEISTUNGSWERKSTOFFE

MATERIALWISSENSCHAFTLICHES KOLLOQUIUM

am 12.01.2011

um 17.15 Uhr – Raum 0506, Geb. K, DE 15

Application of the virtual material models to material microstructure optimization on the example of CFCs and MMCs

Dr.-Ing. Romana Piat,

Heisenberg Stipendiatin, Karlsruher Institut für Technologie

Development of new materials with desired properties is one the main objectives of Material Science. The process can be facilitated by utilization of the methods of numerical mechanics: Numerical microstructure optimization [1] using virtual material models [2-5].

The procedure of the microstructure optimization consists of the following steps:

- Microstructure characterization and identification of the so-called design variables and their bounds. (The design variables are dependent on the manufacturing process, e.g., orientation distribution of the inclusions, their shape etc.) [6-8];
- Development and experimental validation of the virtual material model [6, 7];
- Microstructure optimization using virtual material model approach with geometrical and loading restrictions imposed on the design variables' bounds [8]. Feedback on the parameters of material manufacturing.

All these steps will be described in details for metal-ceramic and carbon/carbon composites.

References

1. Bendsøe MP, Sigmund O. Topology optimisation. Theory, methods and applications, second ed. Berlin: Springer; 2003.
2. Mura T, Micromechanics of defects in solids, second ed. The Netherlands: Martinus Nijhoff; 1987.
3. Nemat-Nasser S. Micromechanics: overall properties of heterogeneous materials, second ed. The Netherlands: Elsevier, 1999.
4. Kachanov M, Safiro S, Tsukrov I. Handbook of Elasticity Solutions, The Netherlands: Kluwer, 2003.
5. Piat R., Schnack E.: Hierarchical material modeling of carbon/carbon composites. Carbon, 41 (11): 2121-2129 (2003).
6. Piat R., Tsukrov I., Mladenov. N., Verijenko V., Guellali M., Schnack E., Hoffmann M. J.: Material modeling of the CVI-infiltrated C-felt. Composites Science and Technology 66(15):2997-3003, 2769-2775, (2006).
7. Ziegler T., Neubrand A., Roy S., Wanner A., Piat R.: Elastic Constants of Metal/Ceramic Composites with Lamellar Microstructures: Finite Element Modelling and Ultrasonic Experiments, Composites Science and Technology, 69 (5): 620-626, (2009).
8. Piat R., Sinchuk Y., Vasoya M., Sigmund O., Minimal compliance design for metal-ceramic composites based structures, submitted in Acta Materialia.

LEXI LANDESEXZELLENZINITIATIVE HAMBURG