Optimal elastic design of CFCs by microstructure modeling using semi-analytical methods

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The aim of the proposed studies is development of the carbon/carbon composite with prescribed elastic properties. To achieve this, a microstructure optimisation problem for estimation of the microstructure with prescribed stiffness is formulated. The design variables of the posed problem are the local fibers distribution, pyrolytic carbon texture in the matrix and porosity. The volume fractions of the fibers and pores in the whole microstructure are fixed. Material properties of the local microstructure of the composite are calculated using virtual models. The semi-analytical homogenization procedures were used for development of these models. Modeling results are compared with elastic properties obtained experimentally by tension and compression test and ultrasonic studies of the bulk material. The numerical model predicting elastic properties of the material with the highest accuracy was identified and utilized for calculation of the optimal microstructure.

Results of the microstructure optimization are verified by some model problems (e. g., for material with maximal Young Modulus in one direction). Approaches to design microstructure for complicated loading cases are proposed.