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Investigation of Chemical Vapor Infiltrated Carbon Fiber Felts by Combined Scanning Force Techniques

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Carbon fiber felts are an ideal system to study chemical vapor infiltration with carbon. To understand the influence of different parameters of the infiltration process on the microscopic properties of the infiltrated felts it is necessary to investigate not only the local surface structure, but also local mechanical properties like elasticity, adhesion and friction. Here we report on a study of infiltrated carbon fiber felts applying a combination of different scanning force techniques including lateral force microscopy (LFM), force modulation microscopy (FMM) and adhesion force imaging in the pulsed force mode (PFM). The results are compared with polarized light microscopy and scanning confocal optical microscopy data. It is shown that LFM, FFM and PFM allow to distinguish not only between carbon fiber and matrix but also between different carbon microstructures within the matrix due to their different mechanical and adhesive properties. As a result, three different microstructures of carbon could be distinguished by scanning force techniques within the matrix: low, medium and highly textured pyrolytic carbon. Furthermore carbon fiber felts were infiltrated at two different gas pressures to study the influence of the total gas pressure during infiltration on the pyrocarbon microstructure.