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From the early stages of pyrocarbon deposition to composite materials – An investigation by scanning probe techniques

Atomic force microscopy (AFM) was employed to study the microscopic structure and the microscopic properties of pyrolytic carbon in different stages of deposition ranging from the early stages to closed layers and infiltrated fibre felts. Pyrolytic carbon was deposited in a hot wall reactor using methane as carbon source gas by chemical vapour deposition or chemical vapour infiltration respectively.

The investigation of the early stages allowed the observation of single carbon islands. Three nucleation mechanisms could be identified. Furthermore, employing an AFM based method, the shear strength of single carbon islands on a substrate could be determined for the first time.

The investigation of the surfaces of closed carbon layers showed island films with typical diameters of about 100 nm. Intermediate phases of pyrolytic carbon were observed for the first time on closed carbon layers.

The dependence of mechanical properties like adhesion force, friction force, contact stiffness on the degree of texture of pyrolytic carbon could be determined by the analysis of carbon/carbon composites.

Additionally, polarized light microscopy and laser scanning confocal microscopy were applied for the investigation of pyrolytic carbon, especially for the determination of extinction angle and degree of texture, respectively. The relationship between extinction angle and optical properties of the sample was calculated to allow for a quantitative evaluation of optical data.