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Direct Observation of Intermediate Phases of Pyrolytic Carbon by Atomic Force Microscopy — ●ANDREAS PFRANG¹, YONG-ZHONG WAN¹, and THOMAS SCHIMMEL^{1,2} — ¹Institute of Applied Physics, University of Karlsruhe, D-76128 Karlsruhe, Germany — ²Institute of Nanotechnology, Forschungszentrum Karlsruhe, D-76021 Karlsruhe, Germany

Although it is technologically highly relevant, the mechanism of pyrolytic carbon deposition is not yet fully understood. Especially the role and even the existence of intermediate phases of carbon during deposition are not clear. In our experiments, islands and layers of pyrolytic carbon were deposited on planar substrates in a hot-wall reactor from methane / argon mixtures. Combined scanning force techniques were applied to reveal two types of islands by different chemical contrast. This observation can be interpreted in terms of an intermediate phase of pyrolytic carbon [1]: for deposition in a regime where the nucleation mechanism dominates, an intermediate phase of pyrolytic carbon was predicted which is expected to have deviating mechanical properties in good agreement with our results of island removal experiments carried out using atomic force microscopy.

Moreover, on layers deposited at sufficiently high methane pressures where adsorption saturation is reached, additional carbon structures exhibiting different chemical contrast were found. This is further experimental evidence for the existence of an intermediate phase of carbon postulated for deposition in the nucleation mechanism.

[1] Z.J. Hu, K.J. Hüttinger. Carbon 40 (2002), 617-636

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