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Microscopic investigations of pyrolytic carbon islands deposited on silicon substrates

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Preferred Topical Area: Membranes, Pyrocarbons, Diamond Films

The physical properties of pyrolytic carbon are strongly determined by the texture, *i.e.* the preferential alignment of the graphene planes with respect to the substrate. To gain insight into the mechanisms of texture formation during chemical vapor deposition, the early stages of carbon deposition were studied. For this purpose, pyrolytic carbon was deposited on planar substrates (silicon wafers) oriented parallel to the gas flow in a hot-wall reactor. Methane / argon mixtures were used at a total pressure of 100 kPa, with residence times up to 3.5 s and a temperature of 1100 °C. Short deposition times, 5 and 60 min, were chosen. Transmission electron microscopy (TEM) was applied for the investigation of the structure and the texture of the deposited material. The surface topography of the layers was studied by atomic force microscopy.

The carbon deposition starts with the formation of isolated carbon islands with sizes in the order of 150 nm at very short residence and deposition times. The size and number density of the islands increase along the substrate, *i.e.* with increasing residence times, until a closed carbon layer is obtained. High-resolution TEM reveals that single islands are wrapped by a thin - approximately 10 nm - high-textured (HT) shell containing low-textured material and some long HT branches (between 7 and 16 nm in thickness). The increase of the deposition time up to 240 min leads to the formation of a closed medium-textured carbon layer at very short residence times.