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Microstructure analysis of a carbon-carbon composite using argon ion etching

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The microstructure of carbon-carbon composites obtained by chemical vapor infiltration of a carbon fiber felt was comparatively studied by reflection light microscopy, transmission electron microscopy (TEM), scanning electron microscopy (SEM), atomic force microscopy (AFM) and laser scanning confocal microscopy (LSCM). Ar^+ ion etching was used to reveal and distinguish structural units of the pyrolytic carbon matrix. Mechanically polished samples, polished and subsequently ion etched samples and fractured samples were compared. The values of surface roughness and surface height after polishing or after polishing and subsequent etching determined by atomic force microscopy and laser scanning confocal microscopy correlate well with the degree of texture of the matrix layers obtained by polarized light microscopy (PLM) and selected area electron diffraction (SAED). The carbon matrix is composed of structural units or “cells”, which contain a carbon fiber and a sequence of several differently textured layers around each fiber. Within high-textured (HT) layers columnar grains are well-recognizable using polarized reflection light microscopy and confocal microscopy. The size of depressions within high-textured carbon layers found by atomic force microscopy after ion etching correlates well with the size of differently tilted domains detected by both transmission electron microscopy and scanning electron microscopy.

Key words: reflection light microscopy, atomic force microscopy, laser scanning confocal microscopy, transmission electron microscopy, scanning electron microscopy, argon ion etching, carbon-carbon composite, pyrolytic carbon