

Examination of Scanning Electron Microscope and Computed Tomography Images of PICA

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ABSTRACT

Micrographs of PICA (Phenolic Impregnated Carbon Ablator) taken using a Scanning Electron Microscope (SEM) and 3D images taken with a Computed Tomography (CT) system are examined. PICA is a carbon fiber based composite (Fiberform[®]) with a phenolic polymer matrix. The micrographs are taken at different surface depths and at different magnifications in a sample after arc jet testing and show different levels of oxidative removal of the charred matrix (Figs 1 through 13). CT scans, courtesy of Xradia, Inc. of Concord CA, were captured for samples of virgin PICA, charred PICA and raw Fiberform (Fig. 14). We use these images to calculate the thermal conductivity (TC) of these materials using correlation function (CF) methods. CF methods give a mathematical description of how one material is embedded in another and is thus ideally suited for modeling composites like PICA. We will evaluate how the TC of the materials changes as a function of surface depth. This work is in collaboration with ETH-Zurich, which has expertise in high temperature materials and TC modeling (including CF methods).

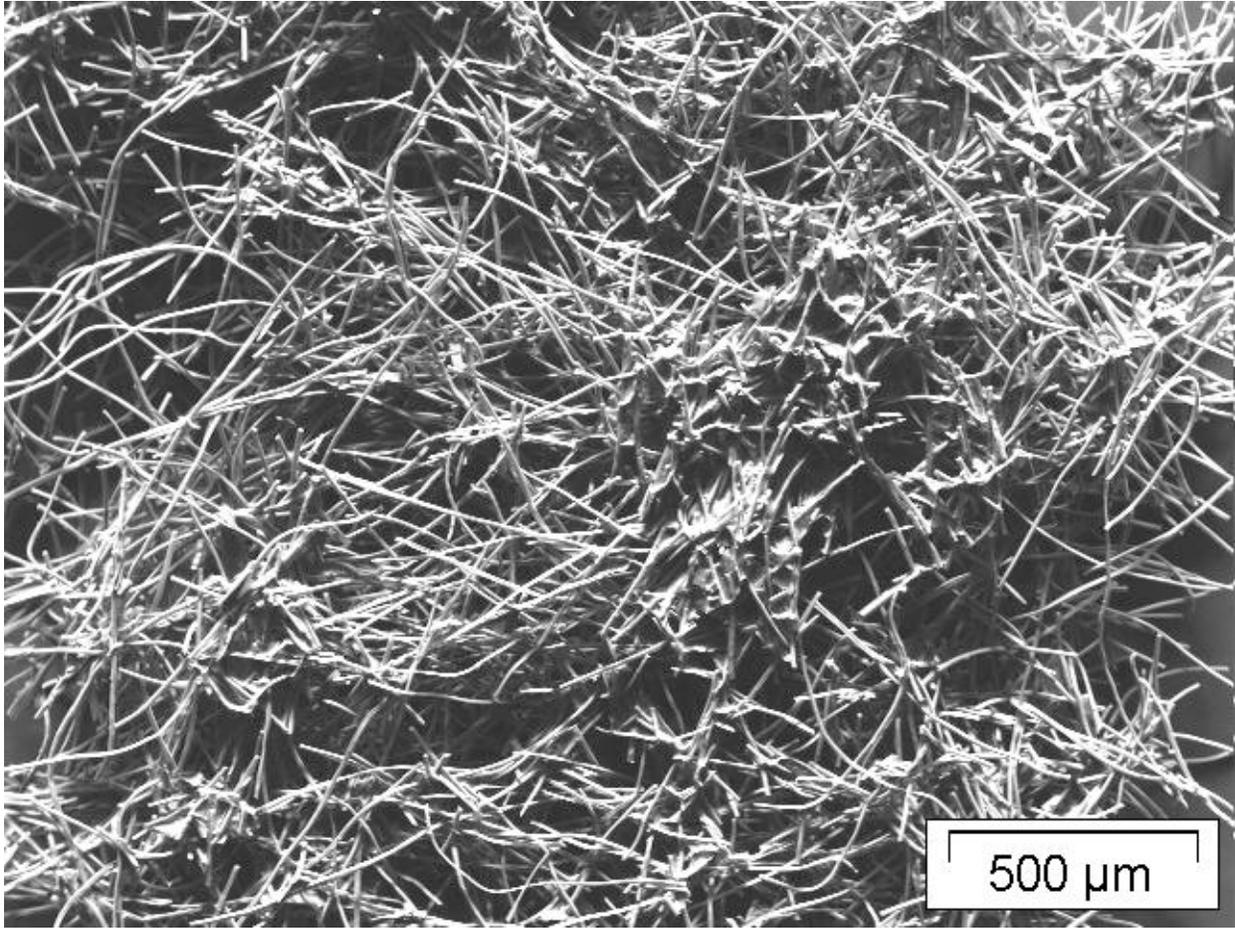


Figure 1. Micrograph of surface ablated PICA char

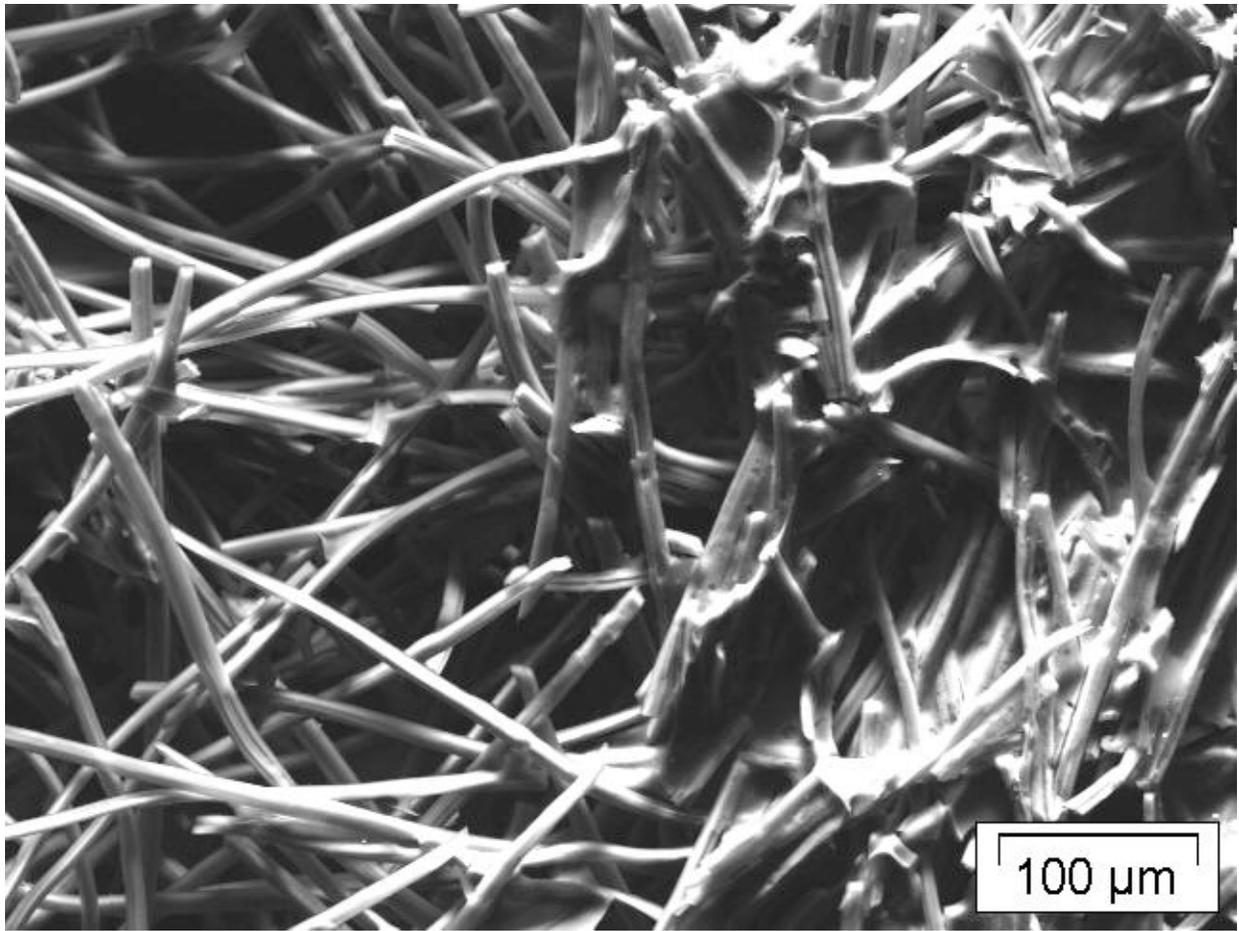


Figure 2. Micrograph of surface ablated PICA char

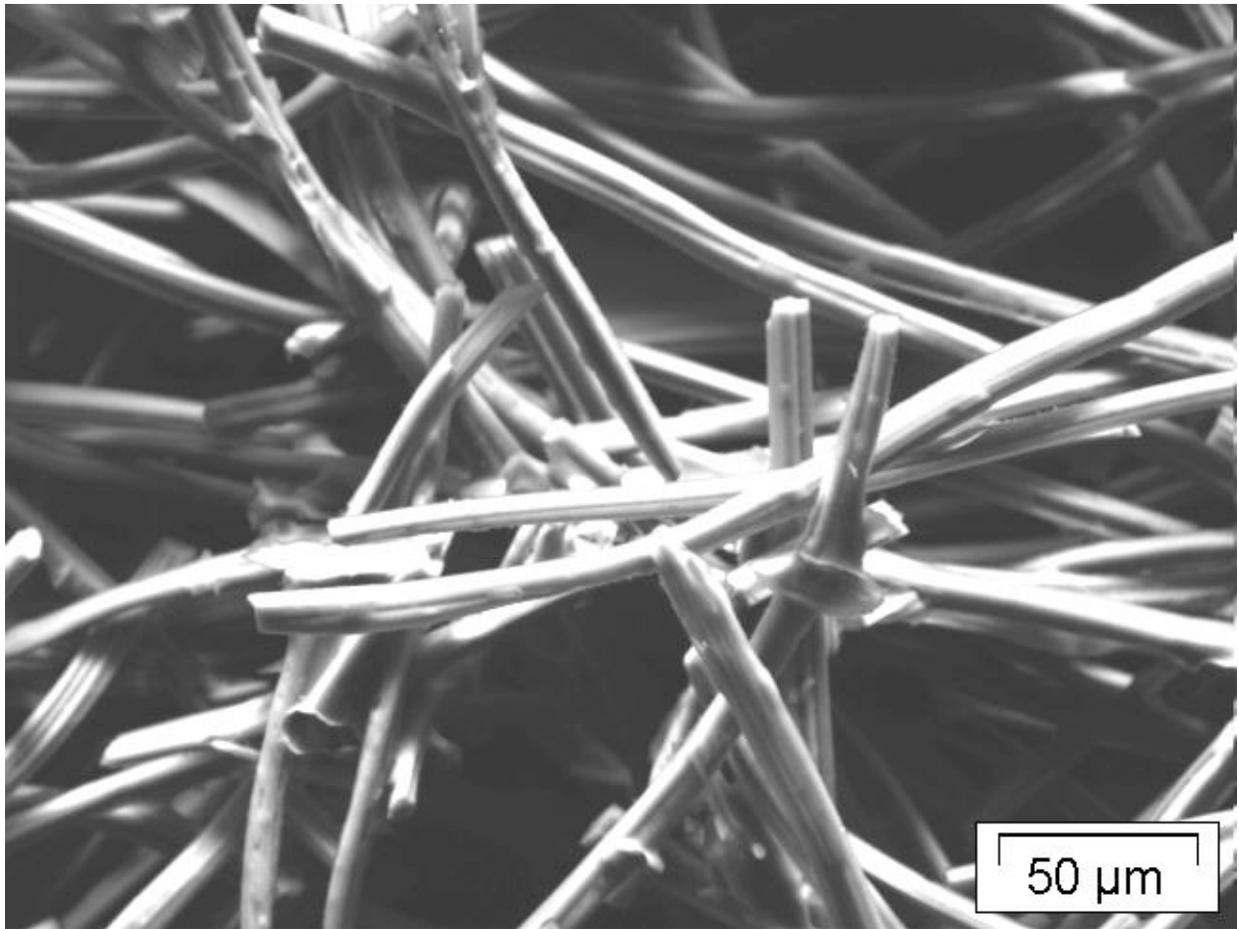


Figure 3. Micrograph of surface ablated PICA char

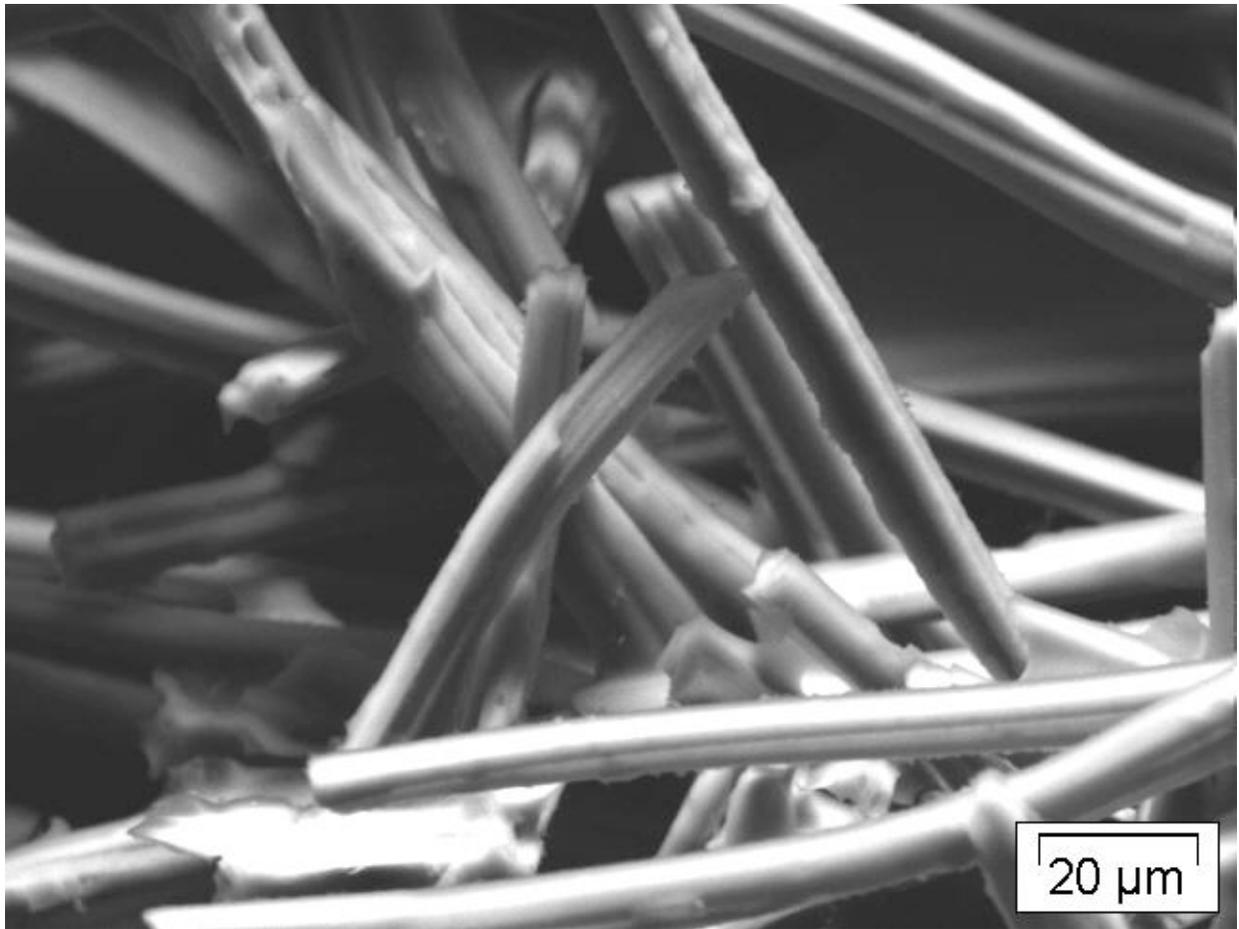


Figure 4. Micrograph of surface ablated PICA char

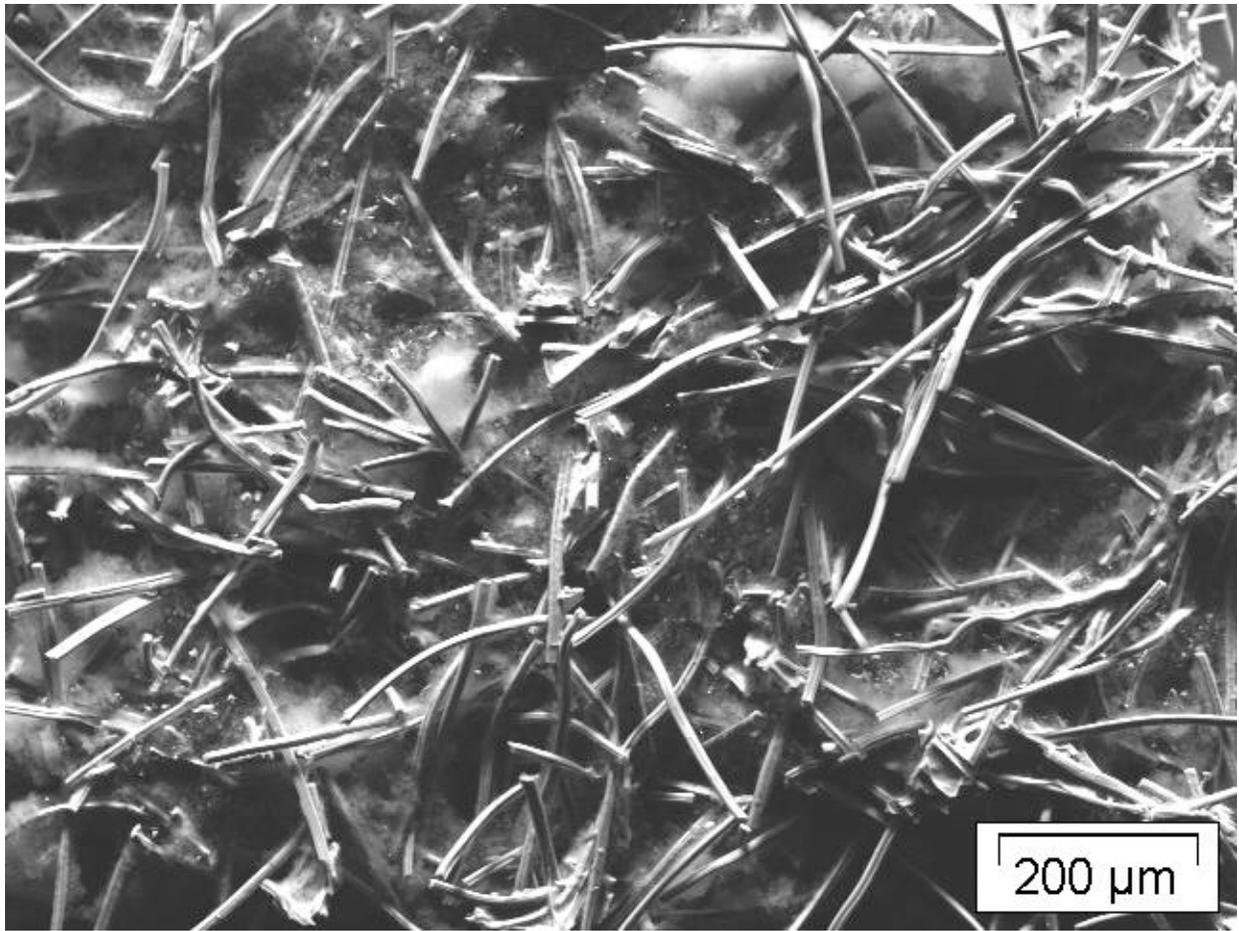


Figure 5. Micrograph of partially ablated PICA ~ 3mm from surface

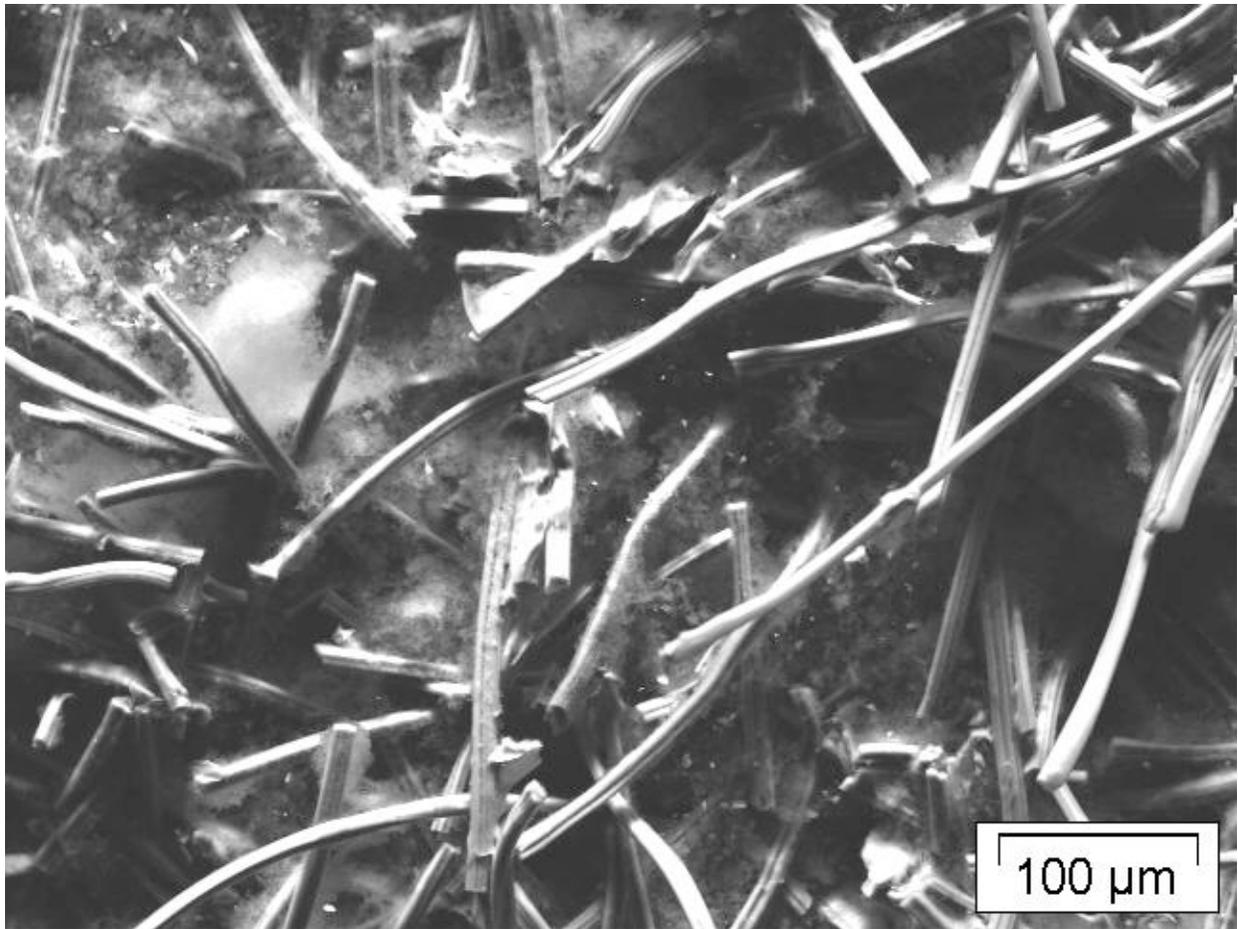


Figure 6. Micrograph of partially ablated PICA ~ 3mm from surface

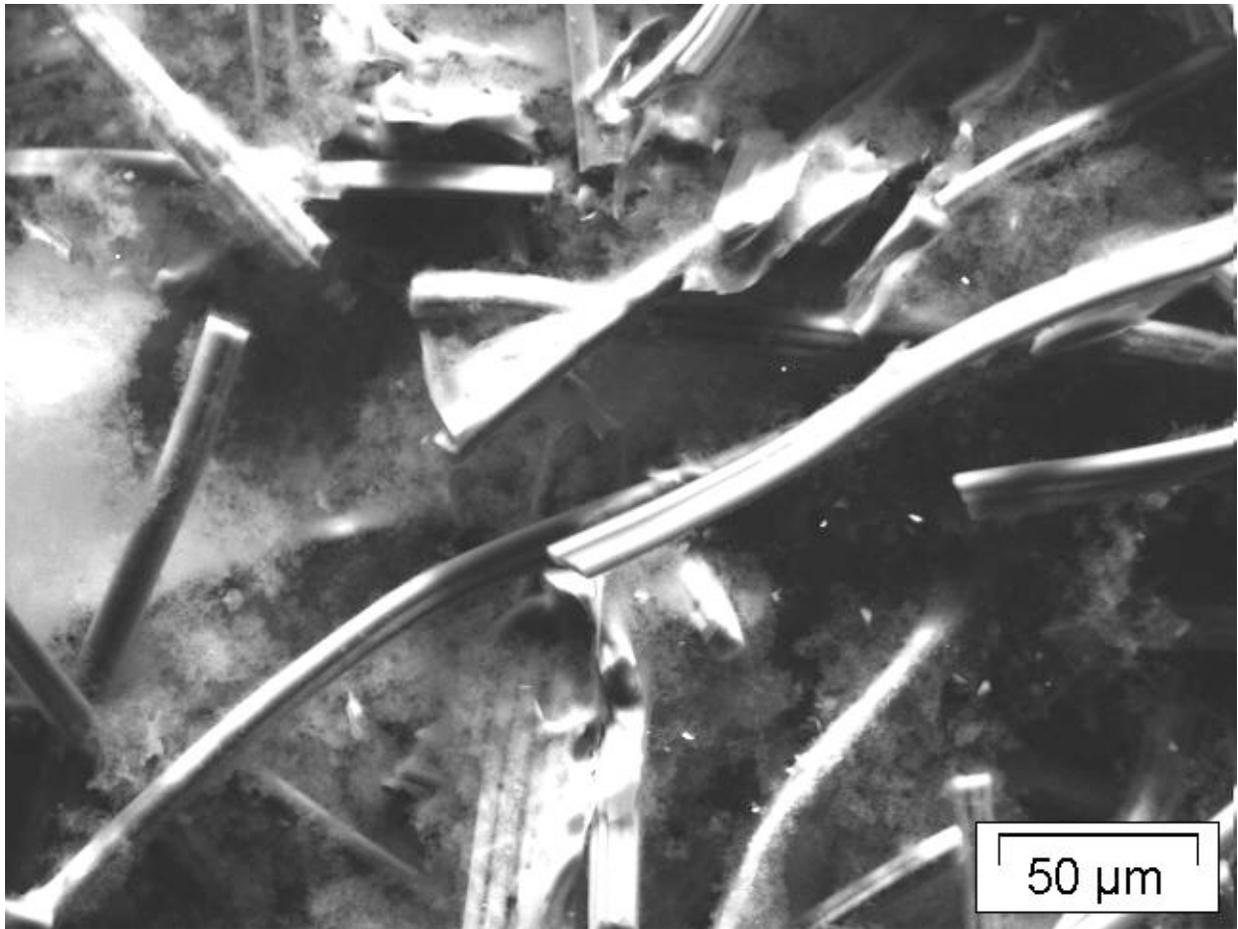


Figure 7. Micrograph of partially ablated PICA ~ 3mm from surface

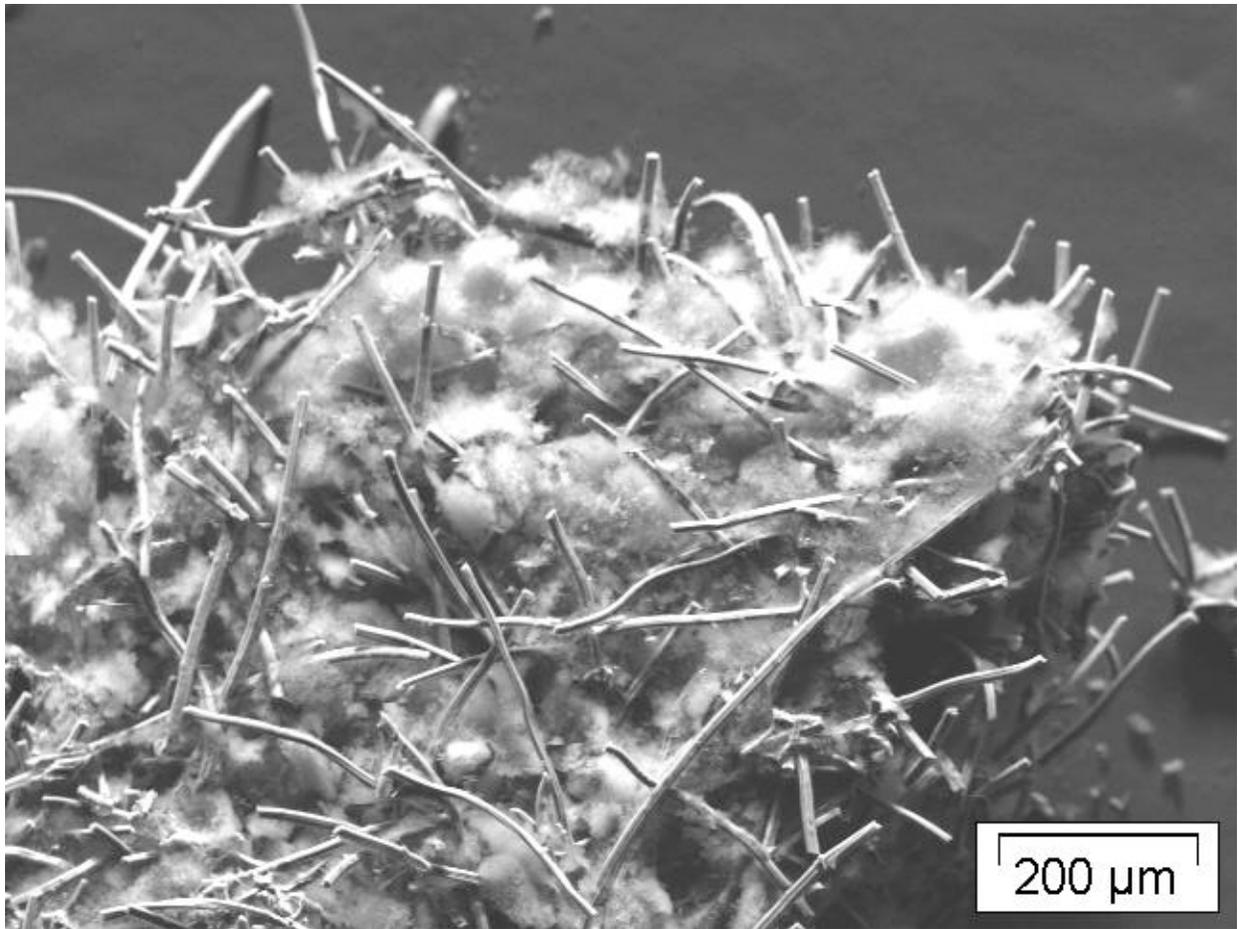


Figure 8. Micrograph of PICA pyrolysis zone

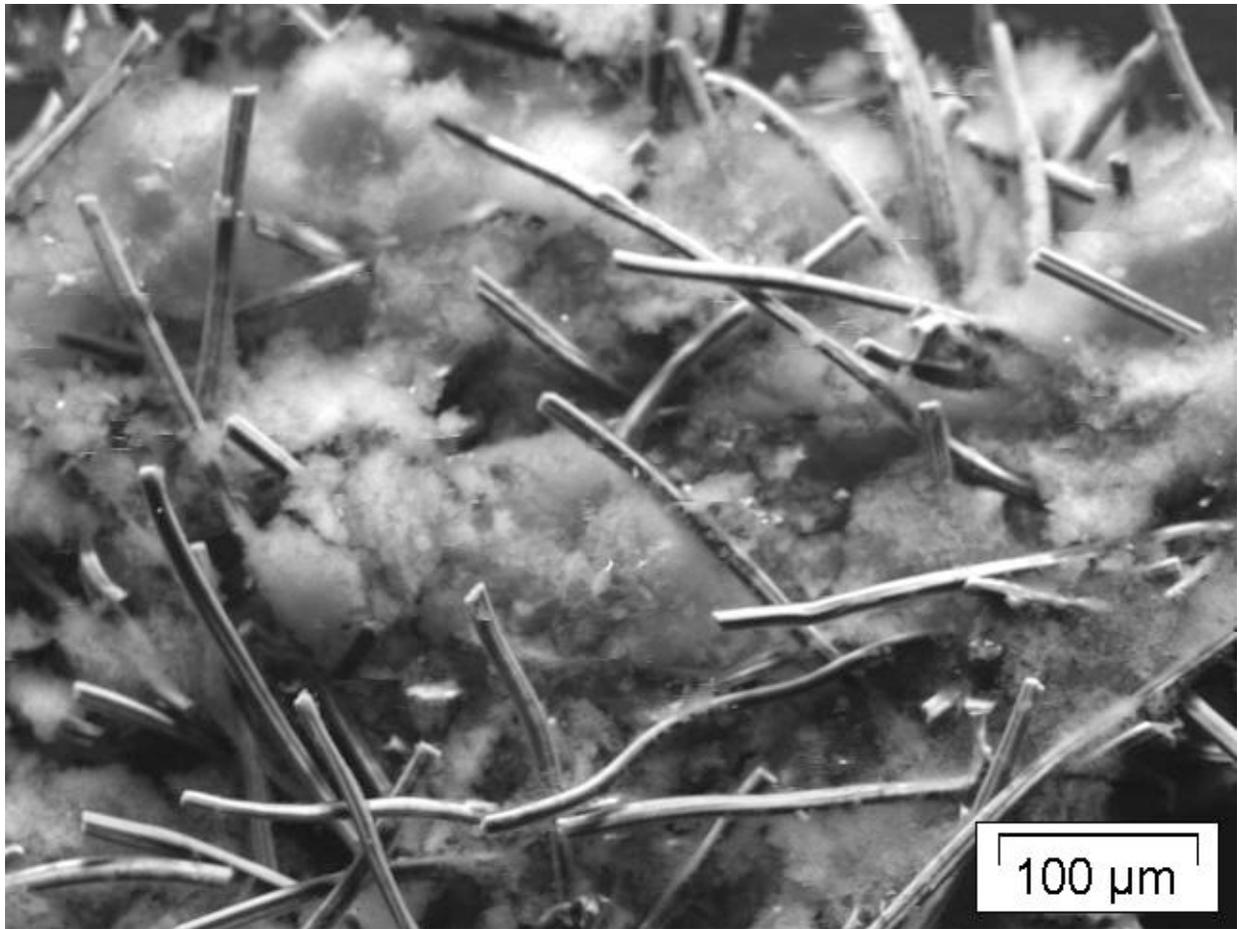


Figure 9. Micrograph of PICA pyrolysis zone

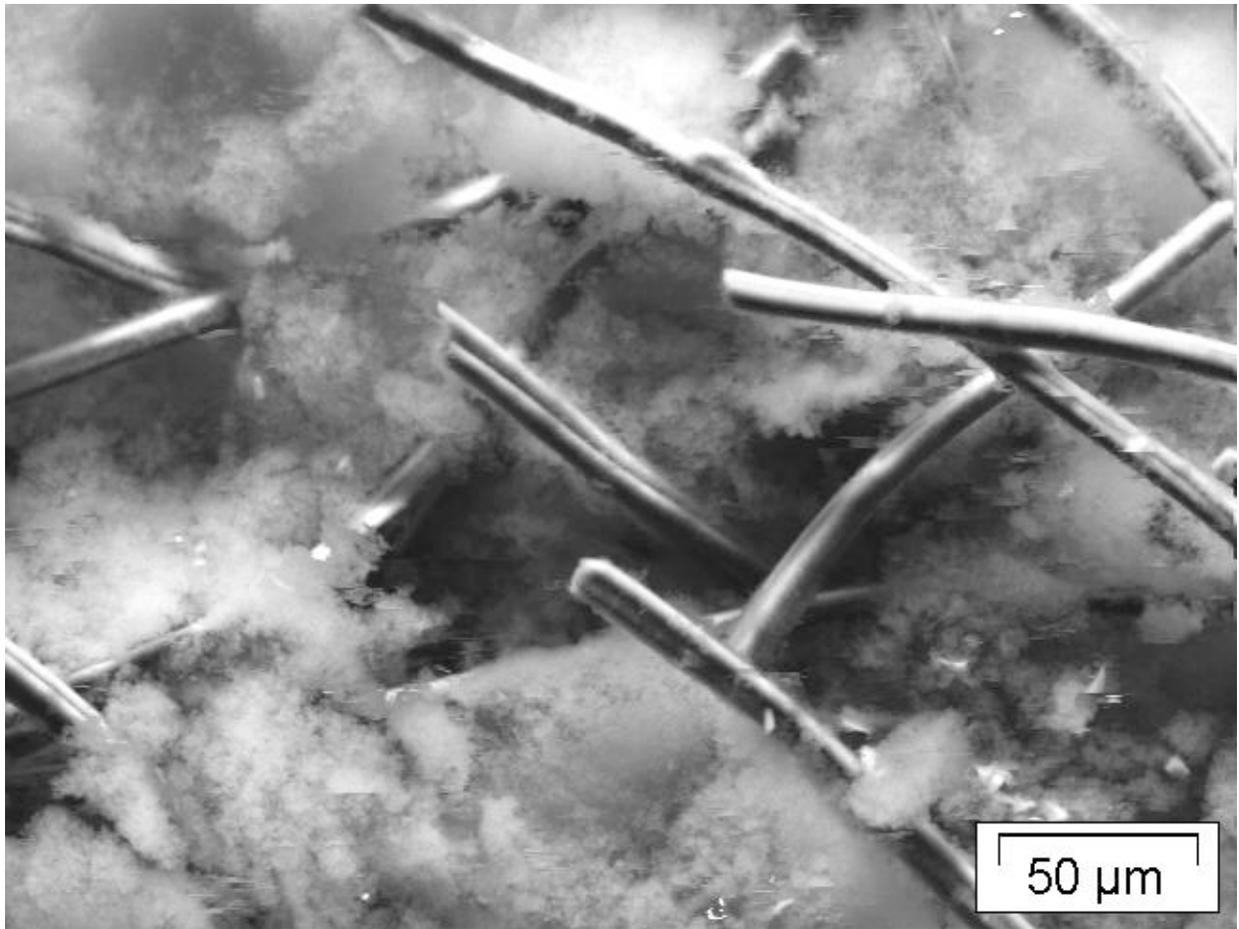


Figure 10. Micrograph of PICA pyrolysis zone

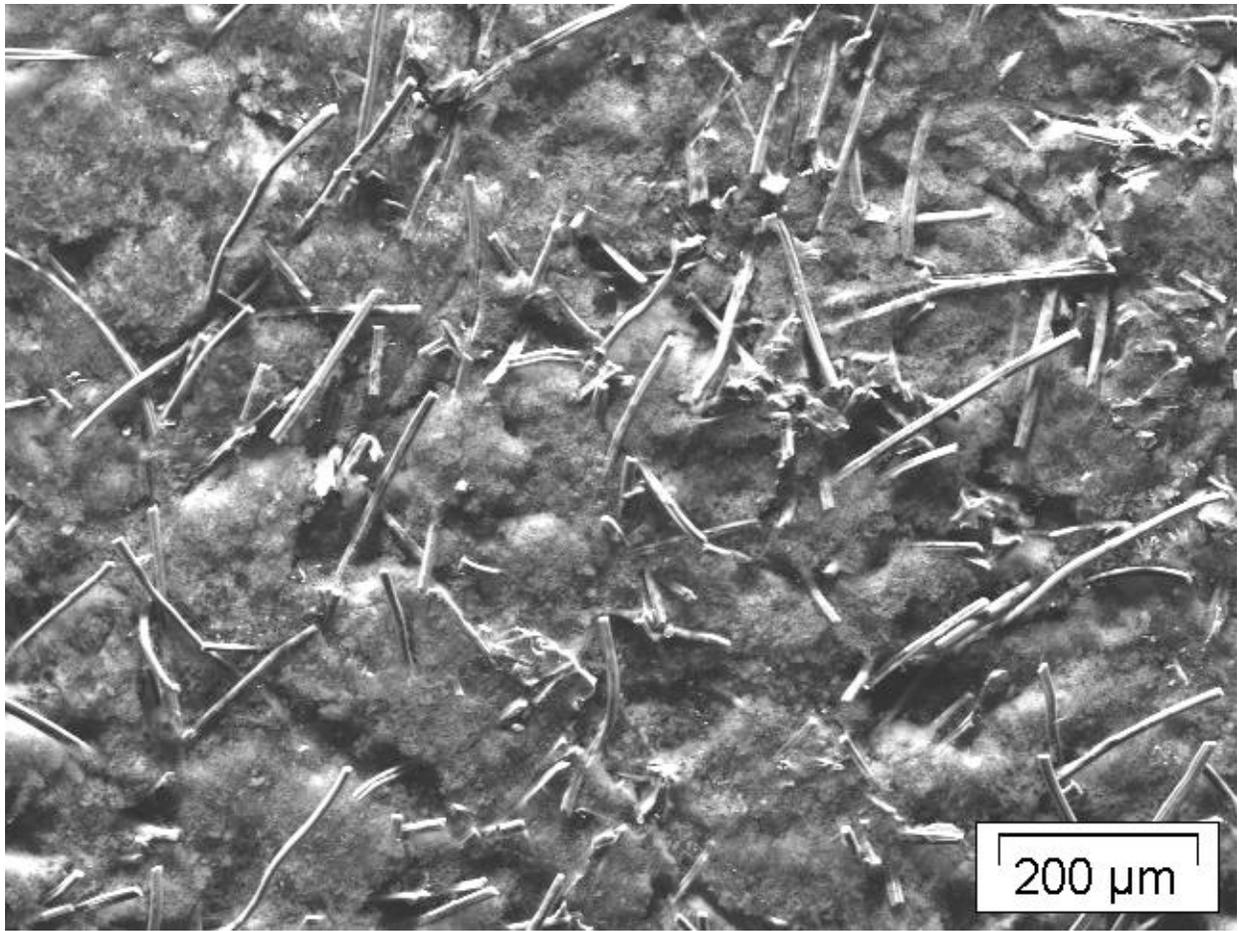


Figure 11. Micrograph of virgin PICA

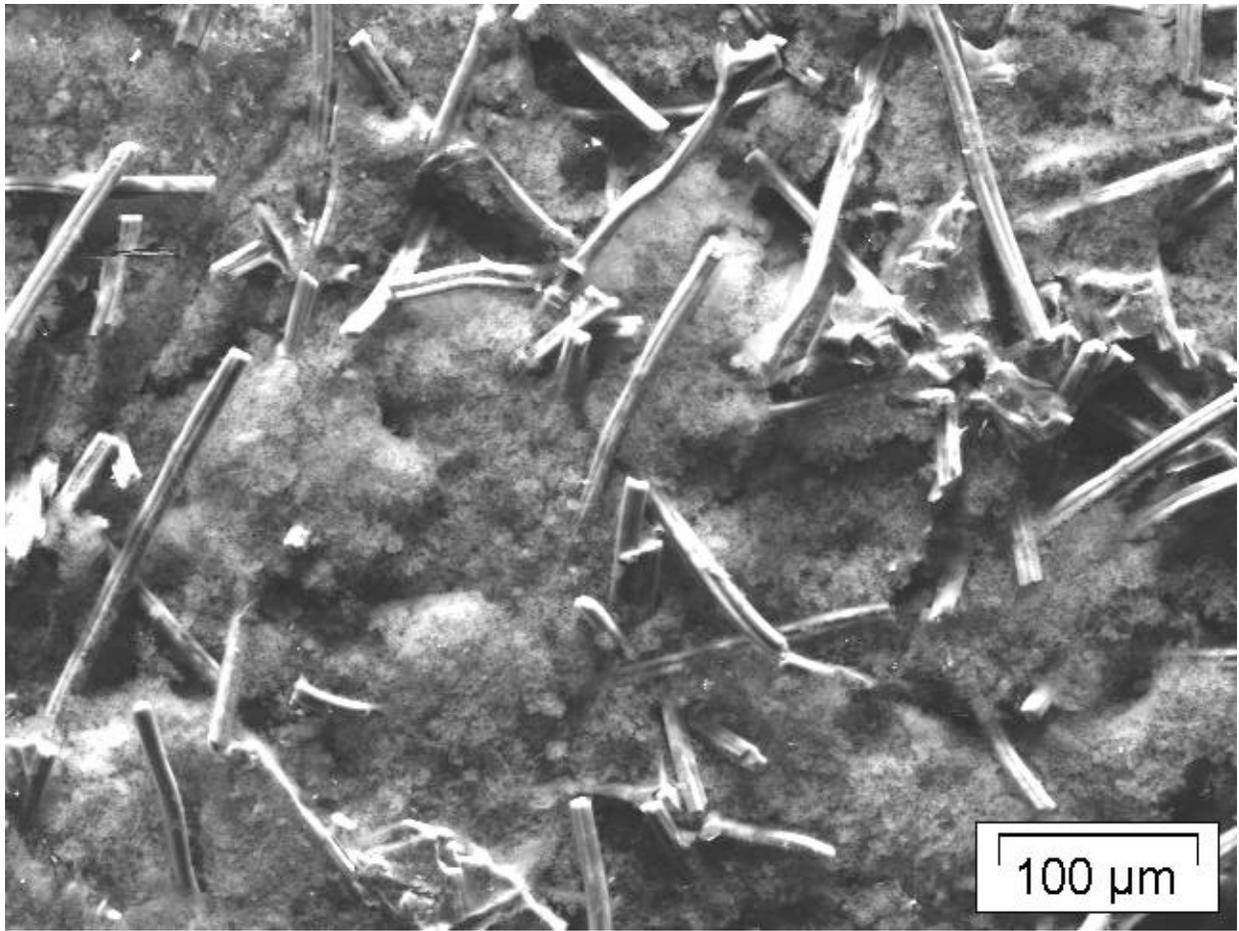


Figure 12. Micrograph of virgin PICA

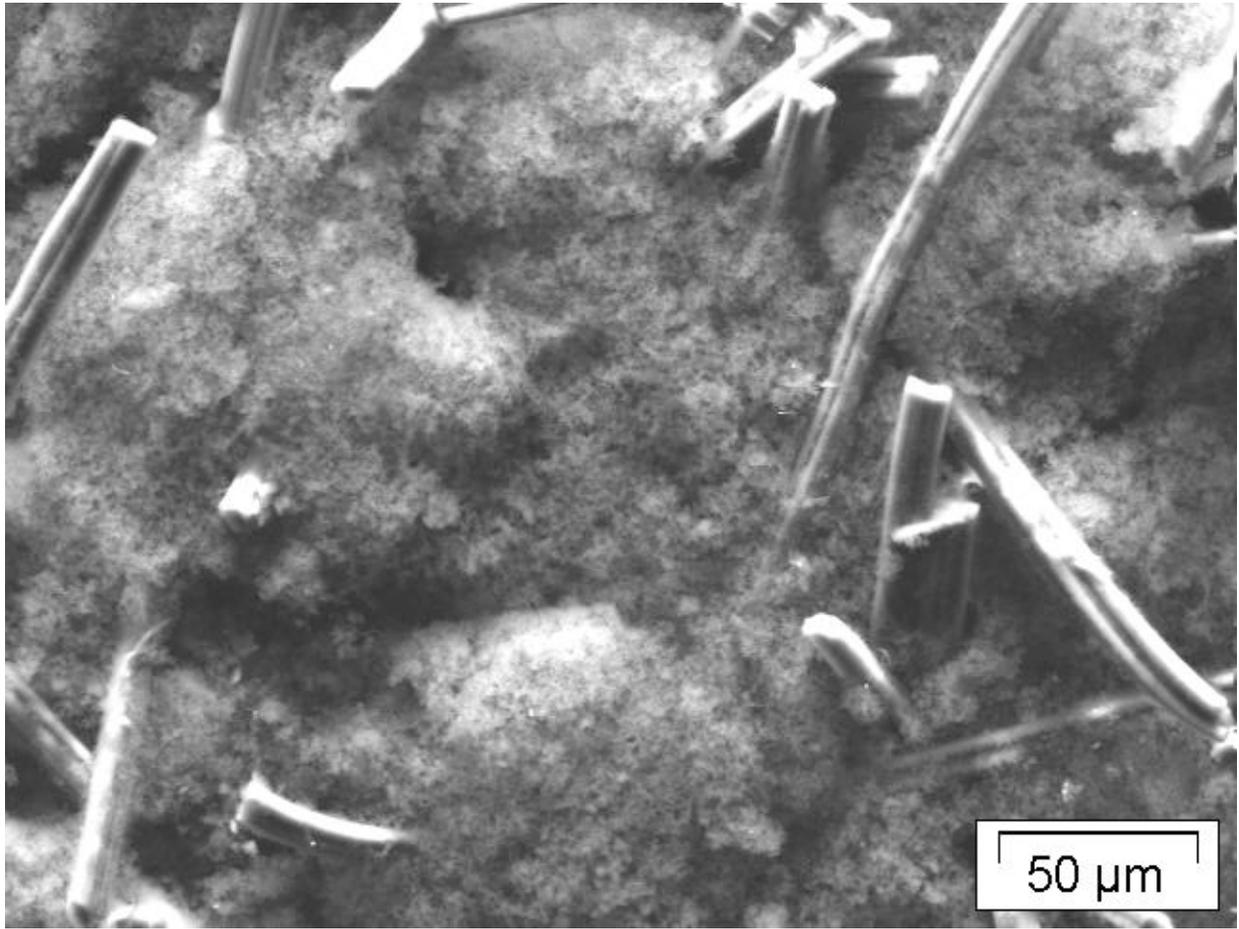


Figure 13. Micrograph of virgin PICA

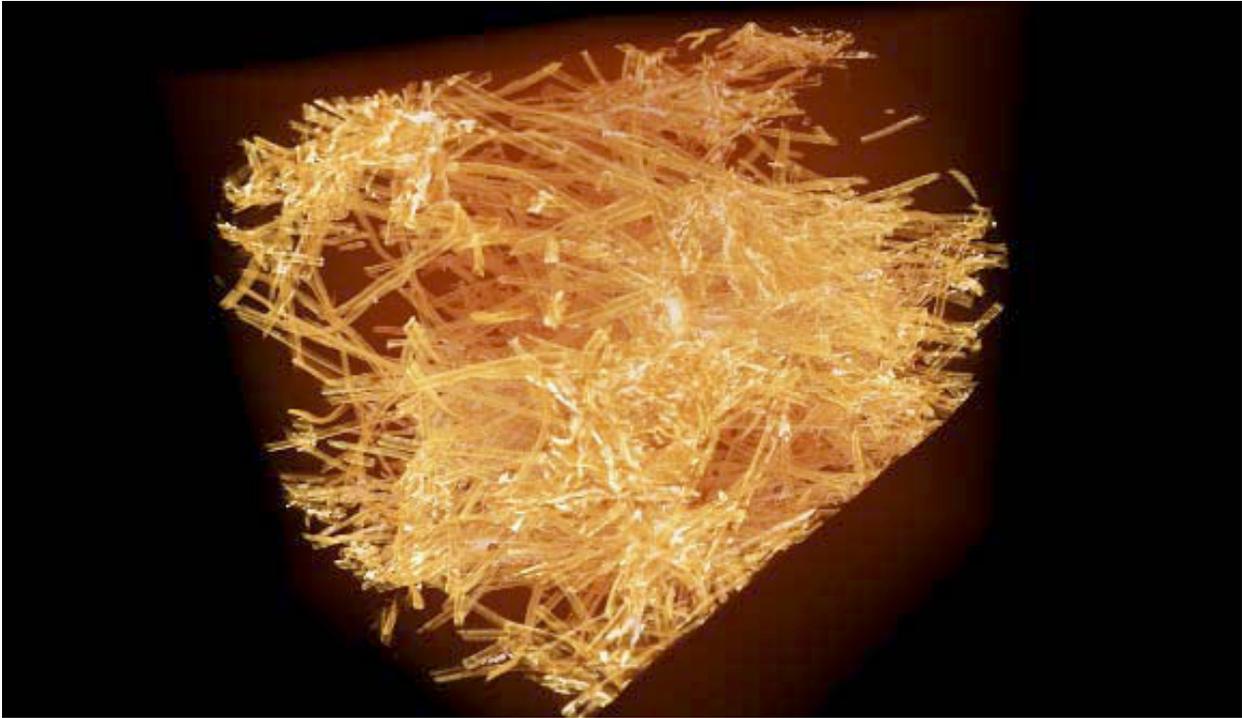


Figure 14. Example of 3D CT image of a Fiberform[®] sample
(Image courtesy of Xradia, Inc. of Concord CA)