Examination of Scanning Electron Microscope and Computed Tomography Images of PICA

John W. Lawson
NASA Ames Research Center

Margaret M. Stackpoole
Eloret Corp

Valery Shklover
ETH-Zurich

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 though 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. Mirograph of surface ablated PICA char
Figure 2. Mirograph of surface ablated PICA char
Figure 3. Micrograph of surface ablated PICA char
Figure 4. Mirograph 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. Mirograph of PICA pyrolysis zone
Figure 9. Micrograph of PICA pyrolysis zone
Figure 10. Mirograph of PICA pyrolysis zone
Figure 11. Mirograph of virgin PICA
Figure 12. Micrograph of virgin PICA
Figure 13. Mirograph of virgin PICA
Figure 14. Example of 3D CT image of a Fiberform® sample
(Image courtesy of Xradia, Inc. of Concord CA)