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SSM ATOMIC OXYGEN REACTIONS ON KAPTON AND SILVERIZED TEFLON

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Surface morphology studies at MSFC using Scanning Electron Microscopy on Kapton and Inconel silver coated teflon material samples retrieved from the Solar Maximum Mission spacecraft revealed significant changes attributed to orbital atomic oxygen - induced reactions. The Kapton recession observed on the aluminized Kapton material samples appeared equivalent in nature with that observed on previous Space Shuttle LEO missions, as expected, based on the comparable mission fluence levels of atomic oxygen (balancing reduced flux levels for the higher SMM orbital altitude with the extended 4-year lifetime). SSM teflon-taped material samples, coated on the back side with films of Inconel-protected, silver were observed degraded on both sides; visibly severe reactions on the back side (Inconel/silver) produced total blackening, generally restricted to areas, or strips, of the tape with a narrow, direct view-factor of the external orbital environment. High magnification S.E.M. views provided evidence of near total silver reaction, flaking, and subsequent erosion of the underlying teflon itself.

MSFC received nine material samples retrieved and cut from thermal-blankets of the SMM spacecraft, including four pieces of Inconel-silver coated FEP teflon and 5 pieces of multi-layer aluminized Kapton blankets (Figures 1 and 2). In Figure 1, the two teflon samples on the left, labeled Samples A and B, are shown viewing the coated back-side, indicating the localized (dark) regions of reaction previously referred to. In Figure 2, the single Kapton sample from the SMM Main Electronics Box (M.E.B.) wrapping shows the pattern of a deliberate ethyl alcohol wipe presumably performed prior to the original launch. No particular analysis has been undertaken at MSFC of the pinholes and/or potential micrometeoroid/debris impact holes observed in these photos of the Kapton samples. The visible diffussiveness of the exposed Kapton samples in these two unmagnified views is attributable mainly to atomic-oxygen induced reaction (pitting, erosion) and, possibly, univestated contamination.

For the purposes of this report, only three of the extensive S.E.M. photographs, (ranging to 20,000 X magnification) illustrating the basic reactions observed, are included pending more detailed investigation by various analytical techniques. For either the Kapton or teflon materials, unexposed (control) samples provide featureless, unrelieved photographic views at all of the S.E.M. magnifications used. Fig. 3 provides magnified views of an eroded Kapton sample from the SSM Attitude Control Systems (A.C.S.) module. Figure 4 provides views of the eroded backside (inconel/silver) coated area of a teflon sample on

the A.C.S. louver structure, showing only shreds of the metallic coating left and the bristle-like reacted pattern of the underlying teflon. For comparison, Figure 5 provides evidence of similar teflon reaction on the teflon exposed side of the sample.

Figure 1.

Figure 2.

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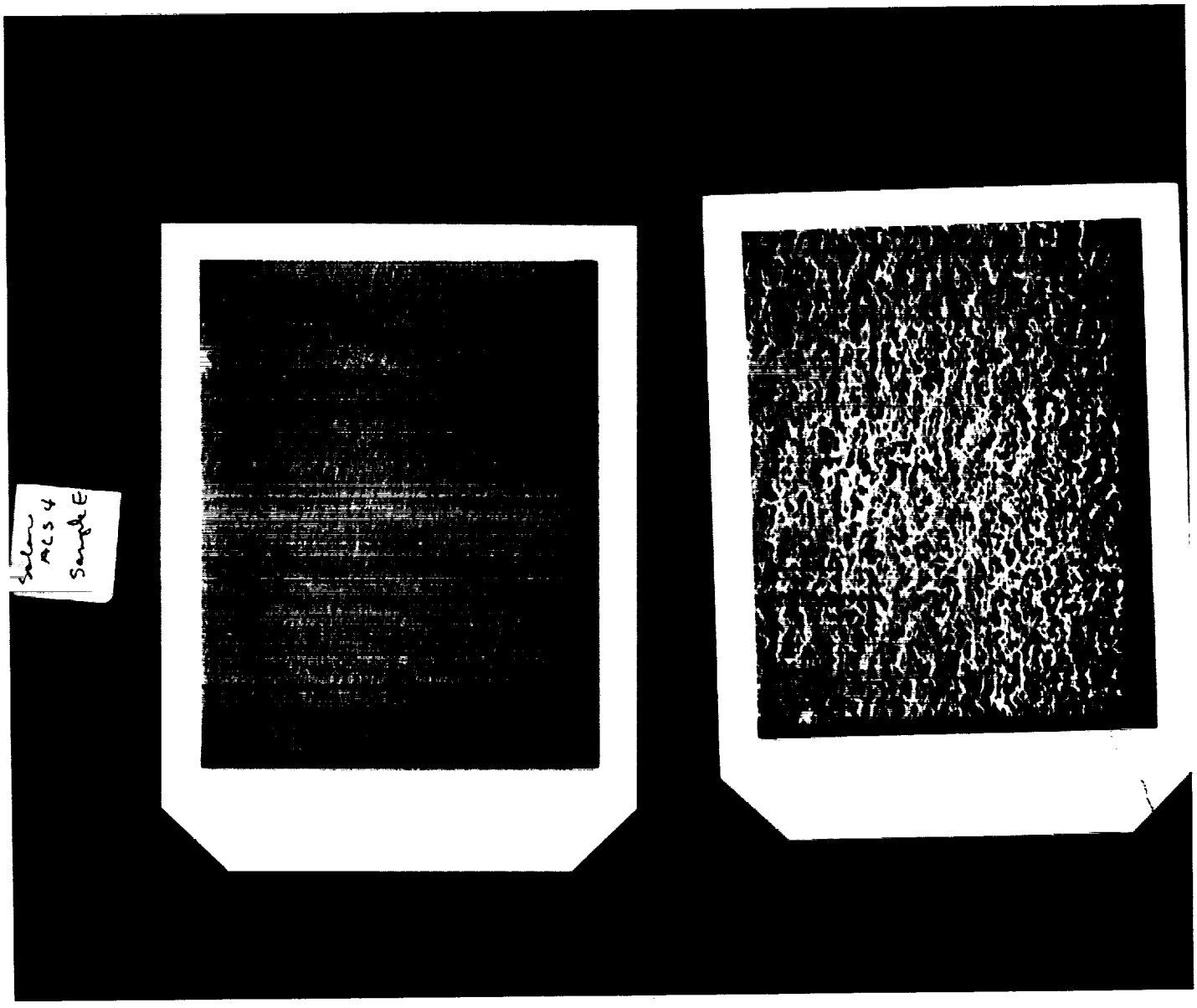
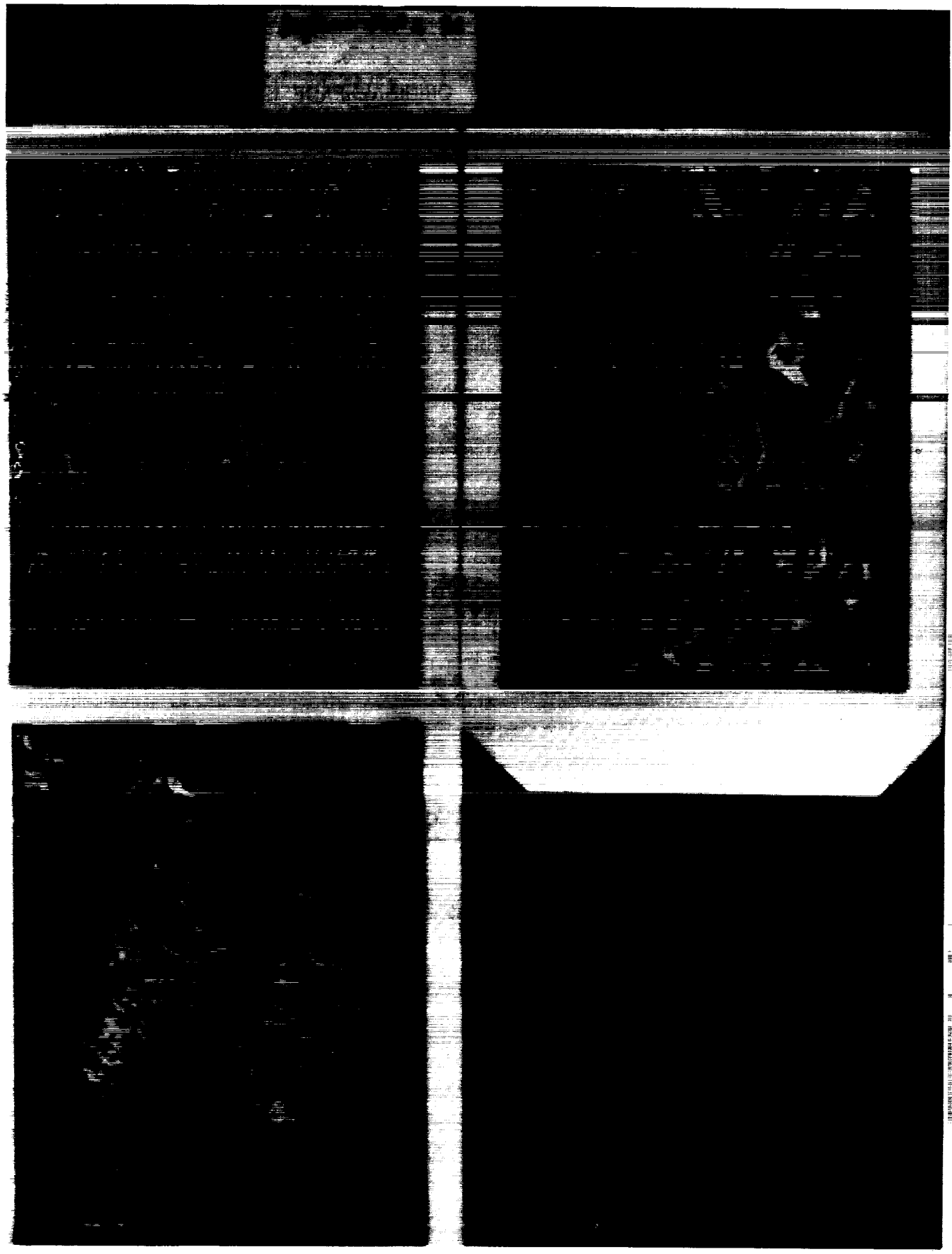


Figure 3.

Figure 4.



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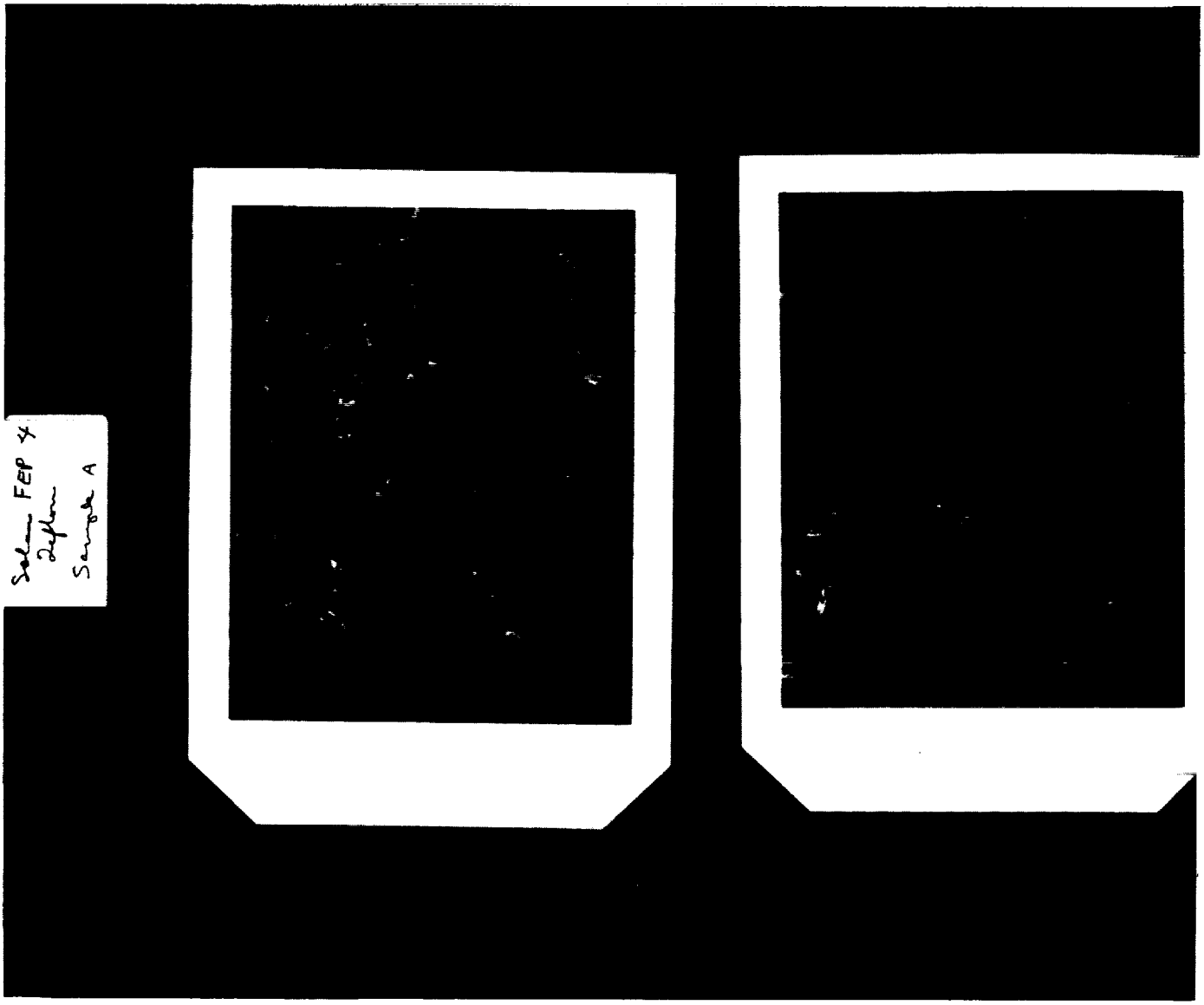

Figure 5.

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