



# Contamination Knowledge Report 1: Polycam Particles Investigation

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## **Summary**

Particulate contaminants on the optical surfaces of Polycam are identified to be predominantly synthetic fibers, with trace animal hairs also present. Based upon SEM-EDX analysis the synthetic fibers are most likely polyester derived from garments.

## **Procedures**

Three optical surfaces were transported to JSC for analysis secured to a substrate. The surfaces were scanned by optical and UV microscopy to characterize the particle populations and identify samples for more detailed SEM study. Two representative fibers were removed and placed on a gold substrate for SEM examination. Secondary electron images and energy dispersive x-ray spectra were obtained from the fibers.

## **Observations**

Fiber 1: One fiber stood out from the main population of fibers on the optical surface due to its linear shape and brown coloration. Low-angle backscatter electron (LAGE) SEM imaging of the fiber (fiber 1, Fig. 1) shows a characteristic scalloped morphology along its entire length. This fiber is approximately 10 – 15  $\mu\text{m}$  in diameter by several hundred  $\mu\text{m}$  in length. The SEM-EDX spectrum obtained from the fiber is dominated by C, N, O and S (Fig. 2).

Fiber 2: The great majority of the contaminants on the optical surfaces were found to be translucent, thin curved fibers. Fiber 2 is an example of this fiber population (Fig. 2). This fiber is approximately 1 mm in length by 10  $\mu\text{m}$  in diameter. Optical microscopy shows this to be a colorless or translucent material. SEM-EDX spectra obtained from Fiber 2 are dominated by C and O.

## **Findings**

Fiber 1: Based on the chemical composition and surface features, Fiber 1 is identified as having a natural source. The appearance is characteristic of animal hair, but the thickness is inconsistent with human hair. Possible sources include cat hair or thin wool.

Fiber 2: Based upon the chemical composition, shape, and morphology, the majority of contaminants are identified as synthetic fibers. The chemical composition is indicative of polyester. A likely source of these fibers is clothing or clean room garments.

**Recommendations**

For more quantitative identification of the contamination source, a follow-up study of candidate contaminants could be performed and FTIR of individual fibers could be used to determine whether the artificial fibers are polyester. The animal hair is a potentially problematic contaminant but it is unlikely to migrate to the returned sample. The polyester is not a cause for concern. Neither contaminate appears to be a concern for Polycam performance.

If additional information is required we can discuss moving to another level of analysis. However, given the information presented we recommend no further investigation of the particles.

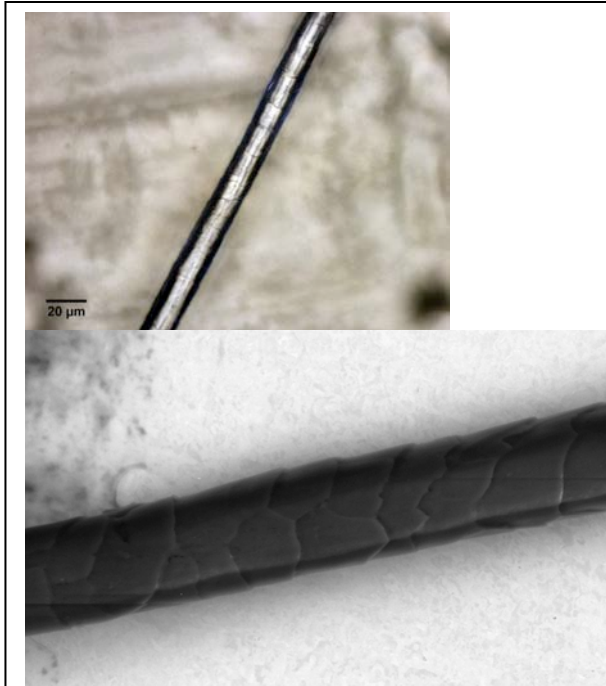


Fig. 1: Optical (top) and SEM (bottom) images of Fiber 1.



Fig. 2: Optical (top) and SEM (bottom) images of Fiber 2.

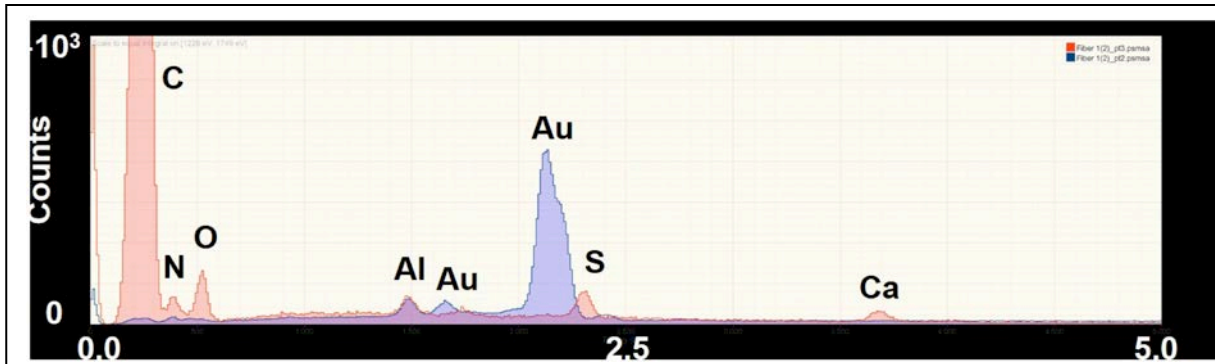


Fig. 3 SEM-EDX spectrum obtained from Fiber 1.

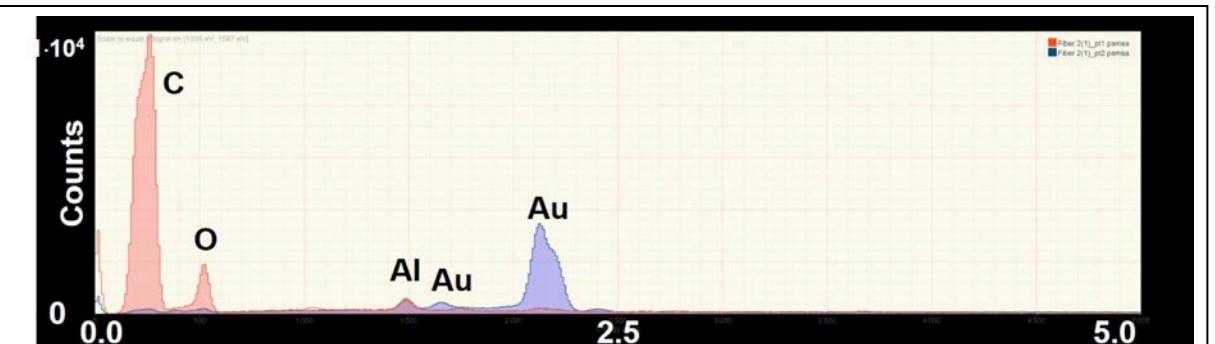


Fig. 4 SEM-EDX spectrum obtained from Fiber 2.