

EXTRACTION REPLICA CLEANING OF GENESIS AuOS AND AIOS. Kimberly R. Kuhlman¹ and Donald S. Burnett², ¹Planetary Science Institute, 1700 East Fort Lowell Blvd., Suite 106, Tucson, AZ 85719, (kim@psi.edu), ²Division of Geological and Planetary Sciences, 100-23, California Institute of Technology, Pasadena, CA 91125 (burnett@gps.caltech.edu).

Introduction: Extraction replicas using cellulose acetate films are being investigated for the cleaning of delicate samples such as gold on sapphire (AuOS) and aluminum on sapphire (AIOS). Megasonic cleaning in ultrapure (Milli-Q) water has been the technique of choice for cleaning Genesis samples [1-3]. The experience of other Genesis investigators has shown that AuOS often delaminates in the presence of water, and that AIOS is moisture sensitive and dissolves in solvents like ultra-dry alcohol [4]. The use of cellulose acetate also makes it possible to analyze the particulates removed from these surfaces [5]. A carbon replica is made by coating the acetate film with a thin carbon film (~50nm), mounting on a TEM grid and dissolving the acetate film, leaving the carbon film containing the particles on the grid. The particles can then be analyzed using scanning electron microscopy (SEM) and transmission electron microscopy (TEM) with energy dispersive X-ray spectroscopy (EDS). Measurements of particulate contamination composition and size and shape distributions can be made.

In the present work, we have focused on demonstrating this technique on a flight-like sample of AuOS, Genesis AuOS sample 60305 and Genesis AIOS sample 41066. All samples were imaged using low voltage SEM (due to the insulating substrate) prior to cleaning using the cellulose acetate film. Series of images were made using low voltage SEM for the entire sample after cleaning. Successively higher magnification images using recognizable landmarks were made where possible.

Cellulose Acetate Replication Technique: To test the feasibility of using this method to clean AuOS, a clean flight-like fragment of AuOS with a distinct mask line exposing the underlying sapphire was replicated using a 125 μm thick cellulose acetate film moistened with acetone until limp. The moistened film was gently placed on the sample while attempting to work from one side to the other to avoid air pockets. Once the film was dry, it basically “popped” off the sample with minimal effort. A second replica of this flight-like sample was made to demonstrate that the technique is safe for undamaged gold. It appears that little or no gold coating was lost in either application of the cellulose acetate film.

The replica is made from cellulose acetate film that is cut slightly smaller than the area of the sample so that the film does not wrap around the edges. This geometry makes the replica more difficult to remove. The use of a hands-free magnifying glass helps to en-

sure accurate placement on the sample, minimal air pockets and draping over the sample edges.

Genesis AuOS Samples 60305: Genesis sample 60305 was obtained from the Genesis curator for the purpose of testing this cleaning method. The sample was considerably smaller than the flight-like sample described above, and was quite dirty and scratched (Figure 1). The sample was replicated using a 125 μm thick cellulose acetate film. The replica appears to have cleaned the gold of nearly all particulates as shown in Figures 2-3. Sections of the gold coating were removed by the acetate film where damage was more extensive since the torn edges of scratches are captured in the film like any other contaminant and removed. As Figure 2 shows, the gold coating remains in large areas of the sample. A series of images near recognizable features was taken both before and after the replica film was applied. The approximate regions of interest are shown in Figures 1 and 2. Before and after images are shown in Figure 3 at approx. 4kX. The replica film appears to have removed submicron particles efficiently, leaving only scratches where particles had dug into the surface.

Genesis AIOS Sample 41066: A fragment of Genesis aluminum on sapphire, sample 41066, was tested using the method. The sample was quite scratched and had shards of rather insulating material on the surface that were easily removed by the replica film. Higher magnification images show that smaller, exotic particulates were removed, but significant aluminum self-contamination (scratching and redeposition with annealing) is more difficult to remove.

Conclusion: Cellulose acetate extraction replica films appear capable of removing particulate contamination at the submicron scale on both AuOS and AIOS without removing the metal coating containing the solar wind from the sapphire substrate. This is of importance since these samples are often ruined if cleaned using the megasonic cleaning technique. Furthermore, multiple replicas can be used to further remove contamination. Further work is needed to prove that the replicas can reliably be turned into TEM samples, which can be used to further characterize the particulate contamination on these and other samples.

References: [1] Allton, J. H. et al. (2006) LPSC XXXVII, Abstract #2324. [2] Allton, J. H. (2007) LPSC XXXVIII. [3] Lauer, H. V. (2005) LPSC XXXVI, Abstract #2407. [4] Jurewicz, A. J. G. (2006) Personal Communication. [5] Brandon, D. (1966) *Modern Techniques in Metallography*. London: Butterworths & Company, Ltd. 266.

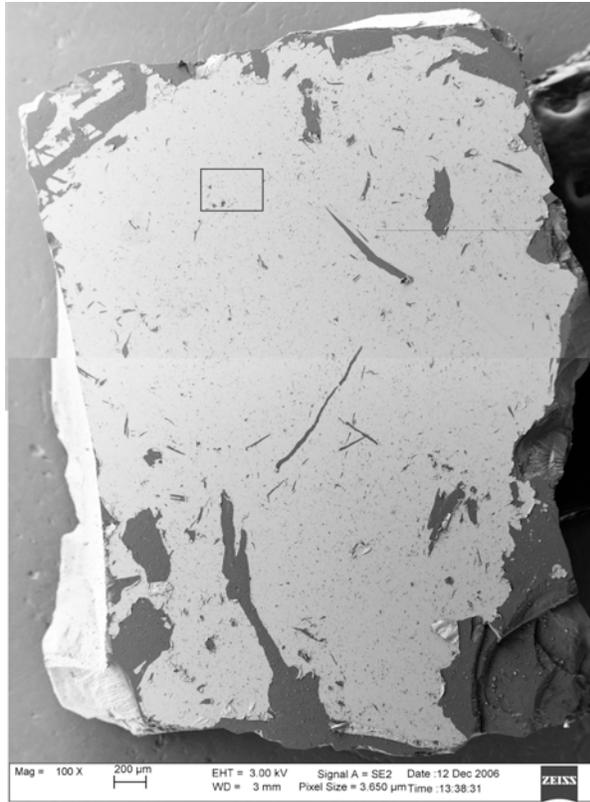


Figure 1. Low magnification SEM montage image of Genesis sample 60305 before extraction replica was applied. No conductive coating has been applied. Figure 3a is centered within the box shown, but of a smaller area.

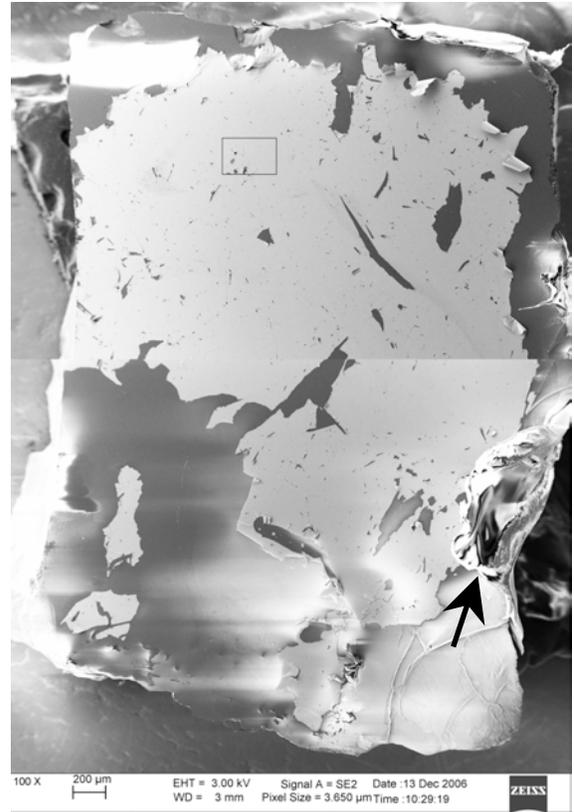


Figure 2. Low magnification SEM montage image of Genesis sample 60305 after extraction replica was applied. Image shows significant charging even with low energy imaging. No conductive coating has been applied. Figure 3b is centered within the box shown, but of a smaller area. Note the replica film remaining as indicated by the arrow.

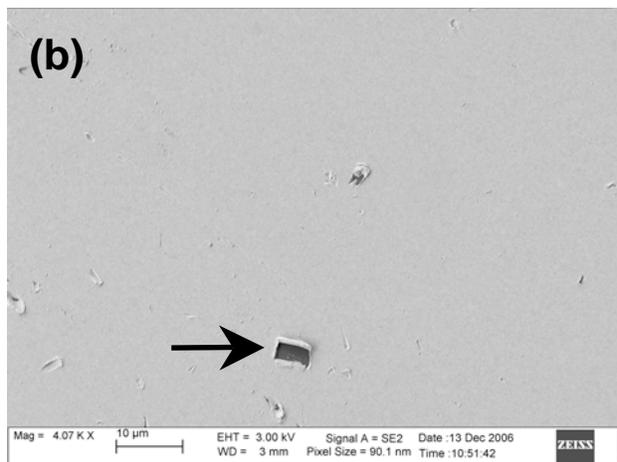
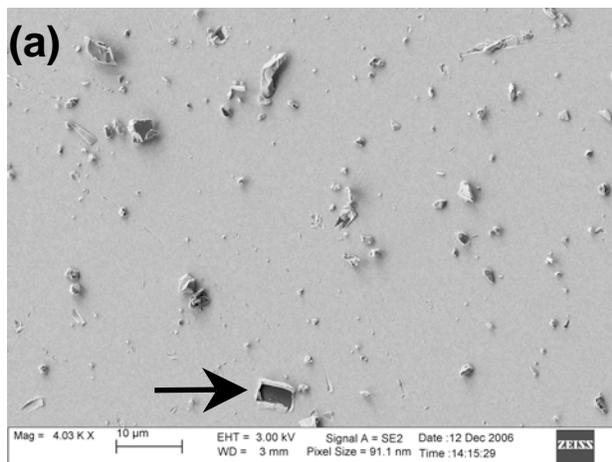


Figure 3. SEM image at approx. 4 kX of Genesis sample 60305 (a) before and (b) after extraction replica was applied. Areas are centered within the boxes shown in Figures 1 and 2. The arrows point to the same feature, a scratch that appears unaffected by the cellulose acetate film.