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Xradia Micro XCT Radiographic Metrology of NIF HED Radiation Transport Ta2O5 Foam Targets

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Xradia Micro XCT Radiographic Metrology of NIF HED Radiation Transport Ta_2O_5 Foam Targets

Data Collection

1. Have Target Fabrication personnel install washer-mounted foam target in holder that contains three tantalum (Ta) reference foils (Figure 1).

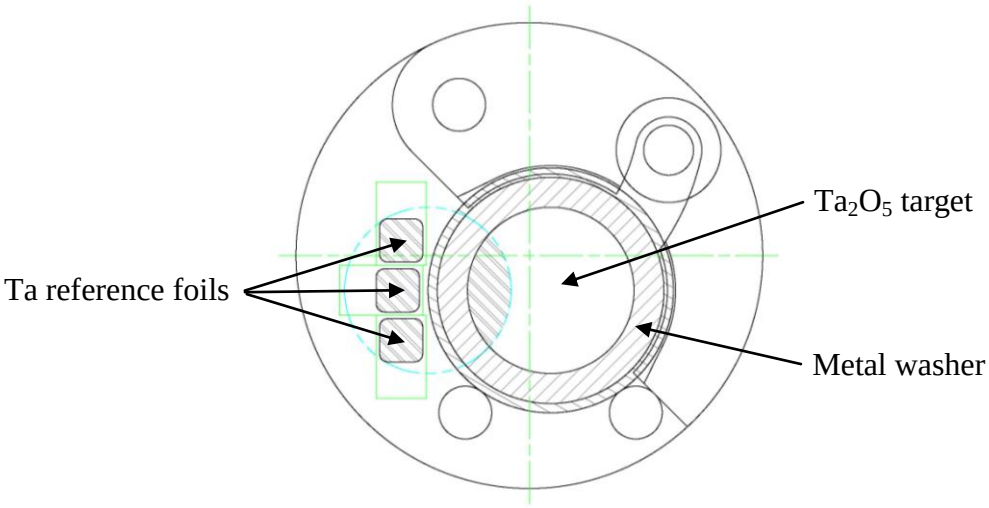

Figure 1

2. Insert the holder into the Xradia Micro XCT system and orient it such that the faces of the target and reference foils are normal to the optical axis of the x-ray beam.
3. Set the Xradia Micro XCT system voltage and current to be 49 kV and 66 μA, respectively. (The anode voltage needs to be set as low as possible to minimize the number of x-rays generated at higher energies. Higher-energy photons will reduce the sensitivity of the foam transmission to foam thickness.)
4. Set the Xradia Micro XCT system magnification to be 4X.
5. Collect one frame-averaged set of exposures (5 frames, 50 secs/frame) of the entire foam target (Figure 2).

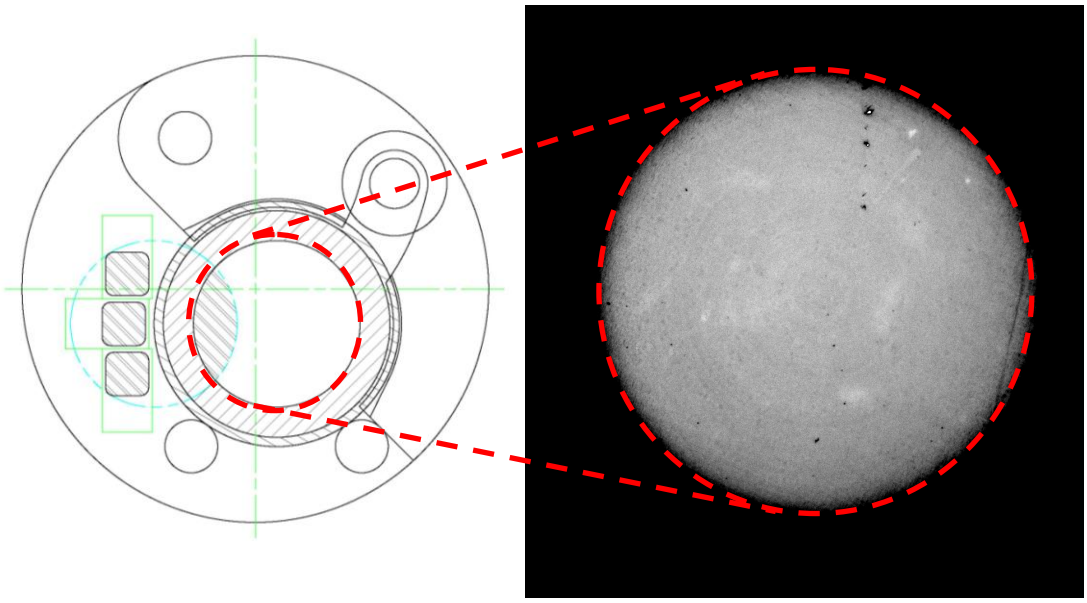

Figure 2

6. Save to disk the raw data file in XRM, BMP, and BIN file formats.
7. Collect one frame-averaged set of exposures (5 frames, 50 secs/frame) that includes all three of the Ta reference foils and part of the sample foam target (Figure 3).

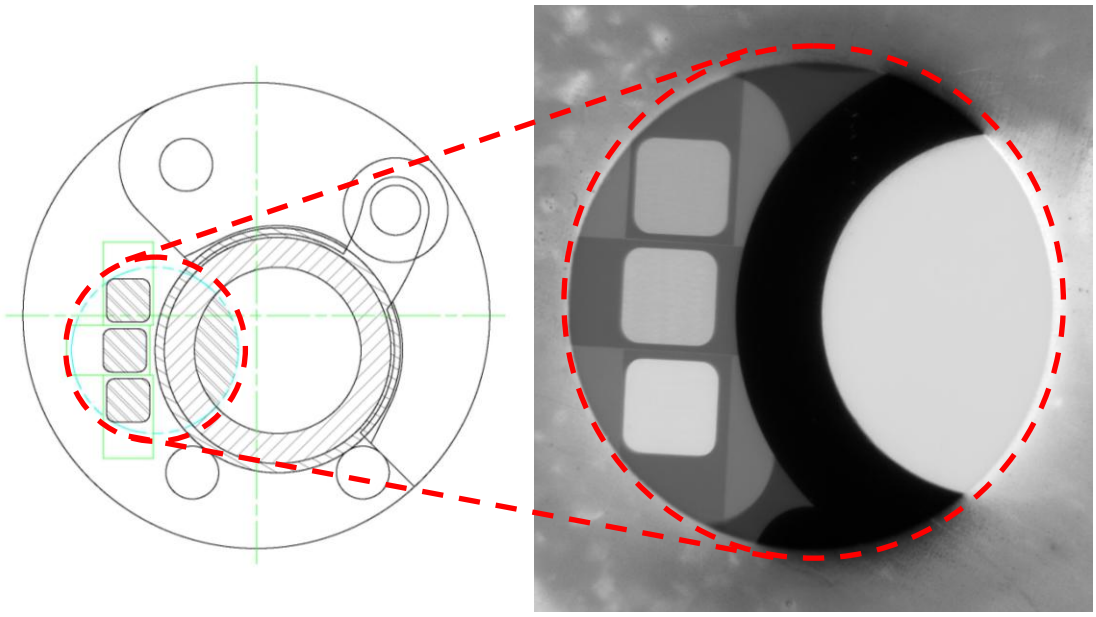

Figure 3

8. Save to disk the raw data file in XRM, BMP, and BIN file formats.

9. Collect one frame-averaged set of exposures (5 frames, 50 secs/frame) of the source with the holder removed from the detector field of view. This set will serve as the background reference data set for the foam target data collected in (4)-(8).
10. Save to disk the background reference data file in XRM, BMP, and BIN file formats.
11. Use software procedure to perform background reference correction. The procedure uses the background reference data set collected in (9) to correct the raw data sets collected in (5) and (7).
12. Save to disk the corrected data files in XRM, BMP, and BIN file formats.
13. Set the Xradia Micro XCT system magnification to be 20X.
14. Collect one frame-averaged set of exposures (5 frames, 50 secs/frame) of a region of the foam target that contains no or very few visually-observable features (Figure 4).

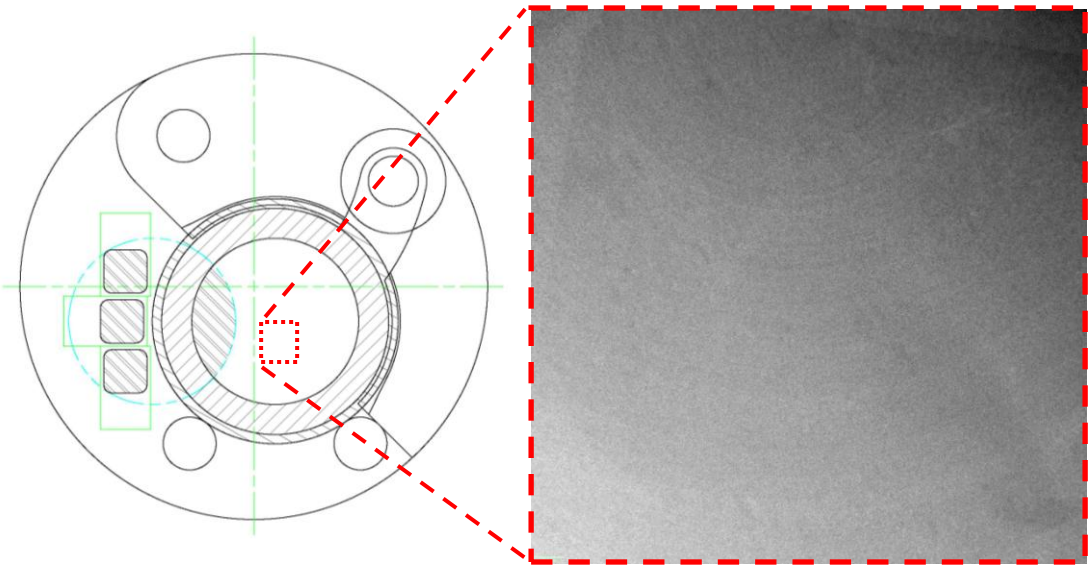

Figure 4

15. Save to disk the raw data file in XRM, BMP, and BIN file formats.
16. Collect one frame-averaged set of exposures (5 frames, 50 secs/frame) of the source with the holder removed from the detector field of view. This set will serve as the background reference data set for the foam target data collected in (13)-(15).
17. Save to disk the background reference data file in XRM, BMP, and BIN file formats.
18. Use software procedure to perform background reference correction. The procedure uses the background reference data set collected in (16) to correct the raw data set collected in (14).
19. Save to disk the corrected data files in XRM, BMP, and BIN file formats.
20. Return holder with installed foam target to Target Fabrication personnel for removal and storage.

Data Analysis

21. For the 4X-magnification radiograph of the entire foam target:
    a. Plot several radial lineouts of the region occupied by the foam target (Figure 5). (Each plot represents the relative x-ray beam attenuation of the foam target as a function of radial position.)

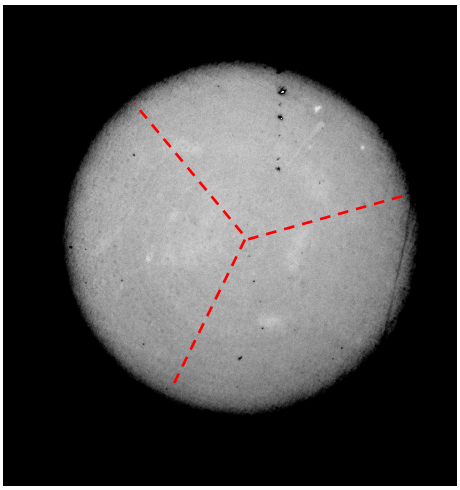

Figure 5

    b. Examine the plots and note any significant changes in sample pixel value as a function of position. (Note: Steve McLaren estimated that the maximum radius of interest – for patterns currently scheduled to be machined into the foam targets – is about 80% of the full radius.)
    c. Plot lineouts through any number of significant, visually-observed features (Figure 6).

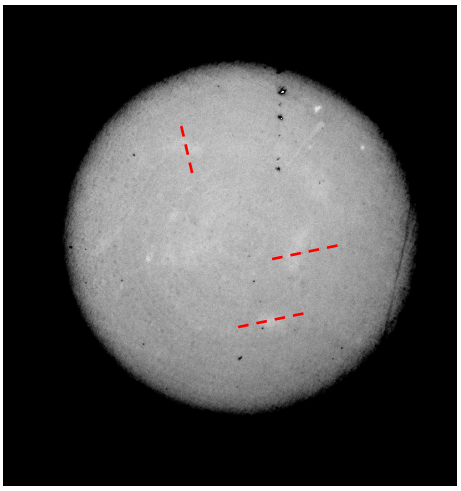

Figure 6

    d. For each lineout, determine if the peak-to-valley (P-V) fluctuations of the sample pixel values exceeds 4% of the mean sample pixel value.

e. *Optional (and to be written): Generate rectilinear array of sample means and standard deviations within target boundaries. Plot the values in a manner that illustrates the variation of the mean as a function of position.*

22. For the 4X-magnification radiograph of all three of the Ta reference foils and part of the sample foam target:
    a. Calculate sample statistics (mean, standard deviation) for a 150-pixel x 150-pixel square region within each reference foil (Figure 7).
    b. Calculate sample statistics (mean, standard deviation) for a 150-pixel x 150-pixel square region within the sample foam target (Figure 7).

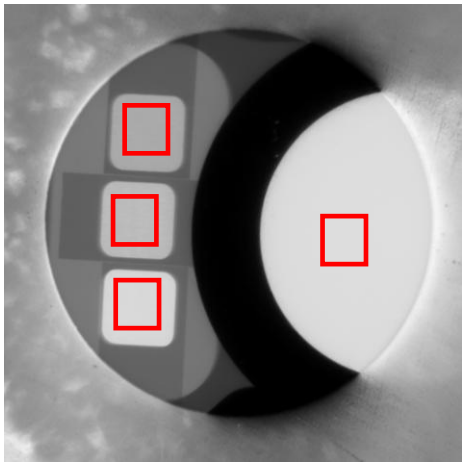

Figure 7

    c. Add the results from (22-a) and (22-b) to a table containing corresponding statistical values for all foam targets characterized in this effort.

23. For the 20X-magnification radiograph of a region of the foam target that contains no or very few visually-observable features:
    a. Plot two lineouts across the region (Figure 8).

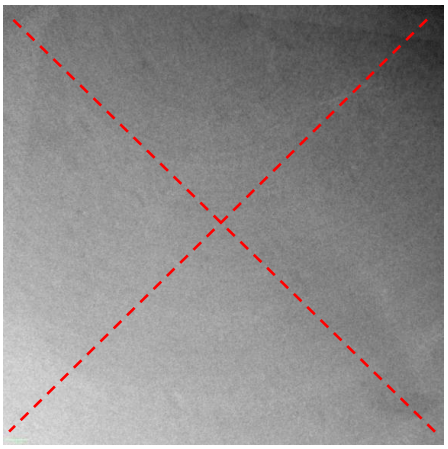

Figure 8

    b. Examine the plots and note any significant changes in sample pixel value as a function of position.