



**Target tungsten  
assembly prototype  
vibration tests**





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## **1 INTRODUCTION**

Vibration tests have been conducted on the Tungsten Assembly Prototype of the ESS target wheel. This report details the surface analysis performed by Scanning Electron Microscopy (SEM) to observe the degradation of the tungsten bricks due to the vibration test. Furthermore, an X-ray elementary analysis has also been carried out on the grains produced during the test in order to clarify their origin.



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## 2 SEM analysis

The assembly under test is composed by eleven tungsten bricks mounted in a stainless steel base and cover, as shown in Figure 1. The dimensions of every brick are 10 mm x 30 mm x 80 mm. Two bricks, coded BTW-5.4 and BTW-5.18, were selected for analysis.

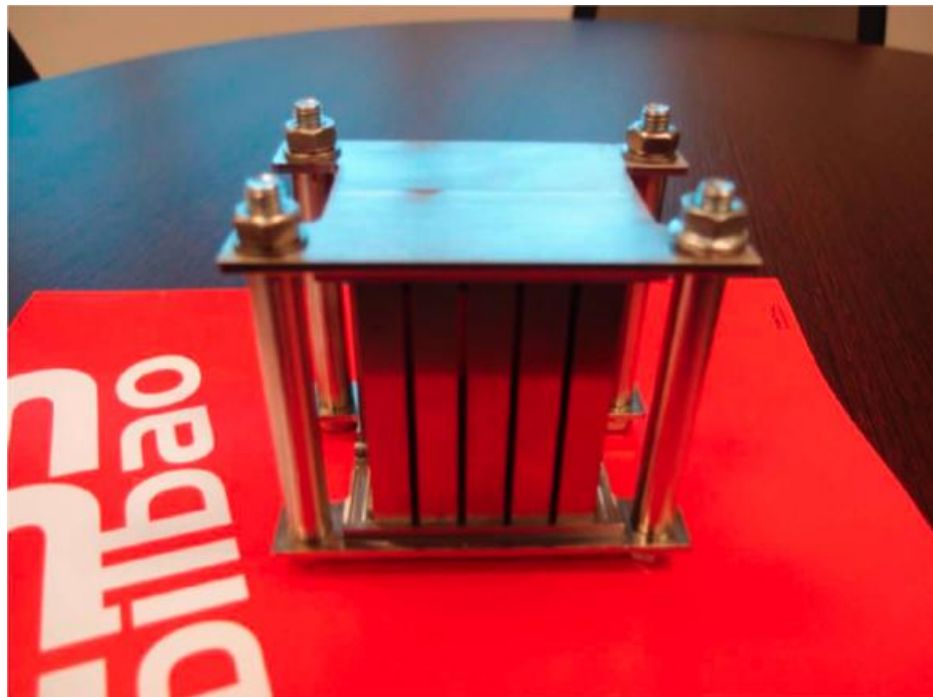


Figure 1. Assembly under test.

According to the procedure, the two bricks were cleaned; then the area of interest was marked with a permanent marker (see upper pictures in Figures 2 and 3) and every brick was placed inside their corresponding plastic bag. Prior to the vibration test, several Scanning Electron Microscopy (SEM) images were taken at different magnifications (left images of Figures 2 and 3). The analysis was carried out using a SEM equipment (Hitachi S3400 N) at the SGIKER of the UPV/EHU. It can be noticed that the surface finish of the two specimens under inspection is very different.

After the SEM analysis, the two bricks were placed in the assembly and the vibration test was conducted, as described in the test report V16001-INR-01. Next, the assembly was carefully demounted and the area of interest of the two selected bricks was imaged again by SEM. Images at the same magnification are shown in the right part of figures 2 and 3 for comparison. The main conclusion that can be drawn from the comparison of the pre- and post- test images is that there is no significant evidence of surface modification and/or degradation due to the vibration test.

During the demounting process of the assembly a few debris (powder grains) were collected. Using a 7 digits precision balance with 2 g maximum weight (from the UPV/EHU SGIKER) the weight of the collected grains was determined. The obtained value was **0.0364 mg**, which can be used as a minimum estimation of the amount of powder produced. It has to be noticed that some grains could have been lost during manipulations.



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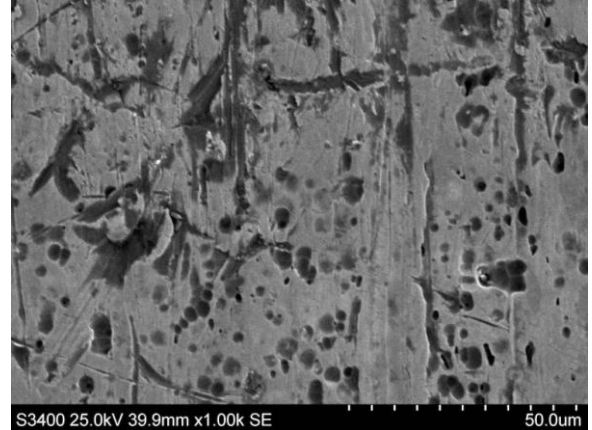
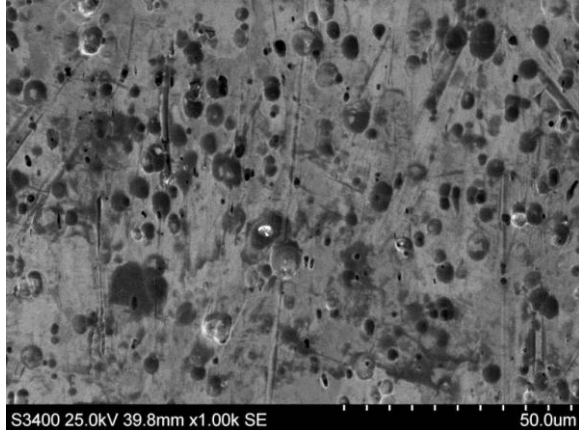
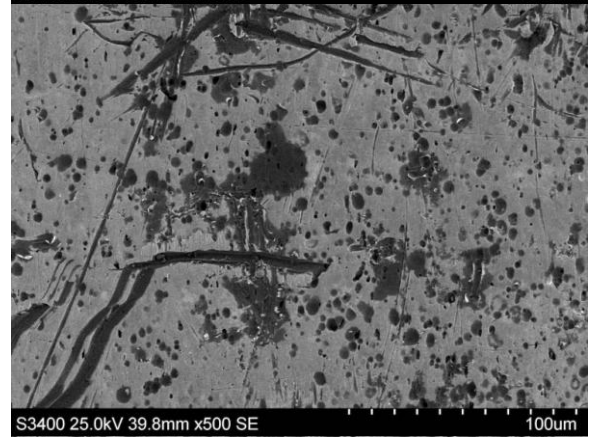
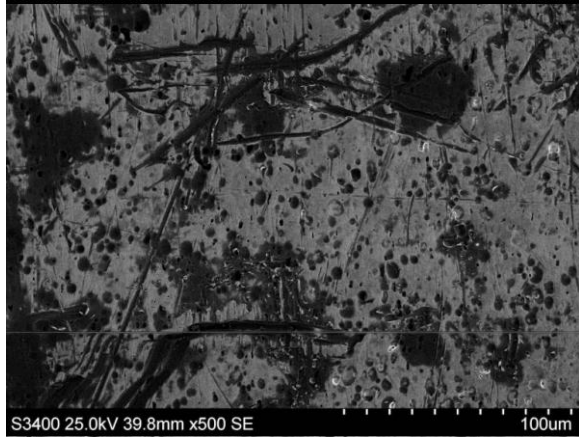
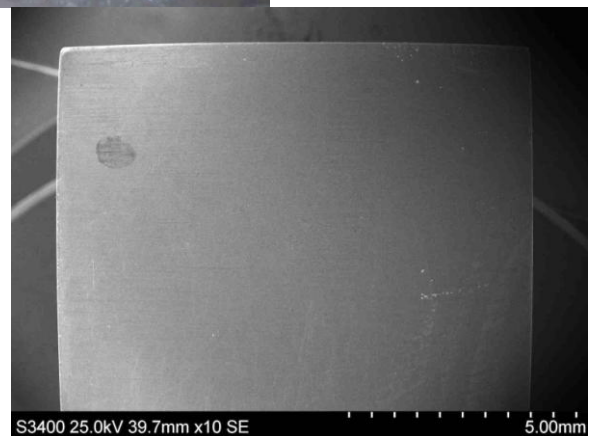
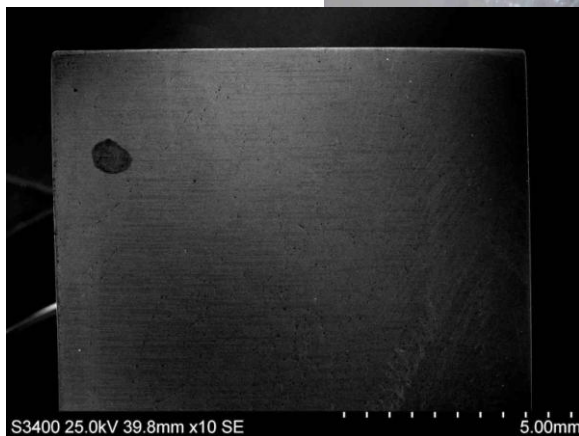
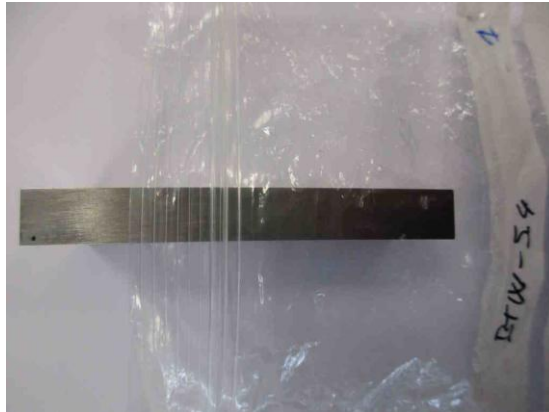
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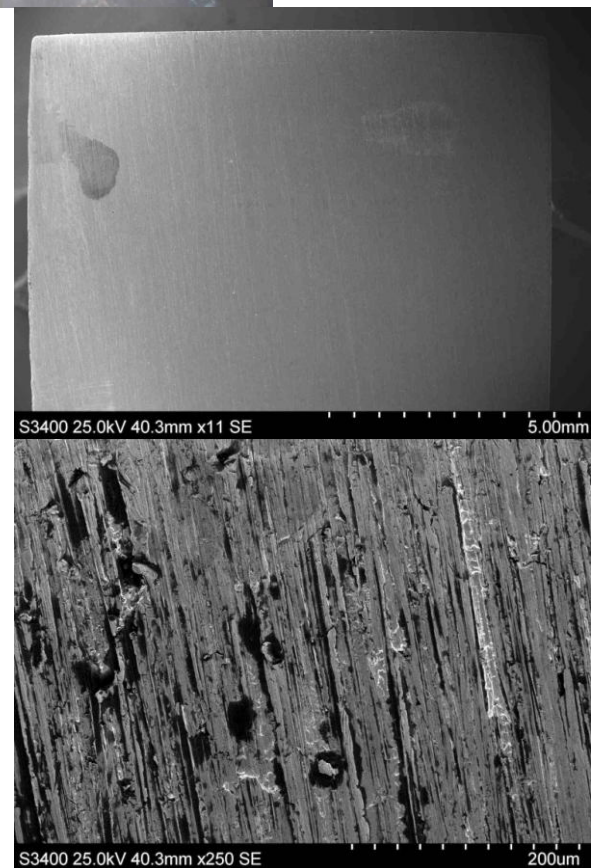
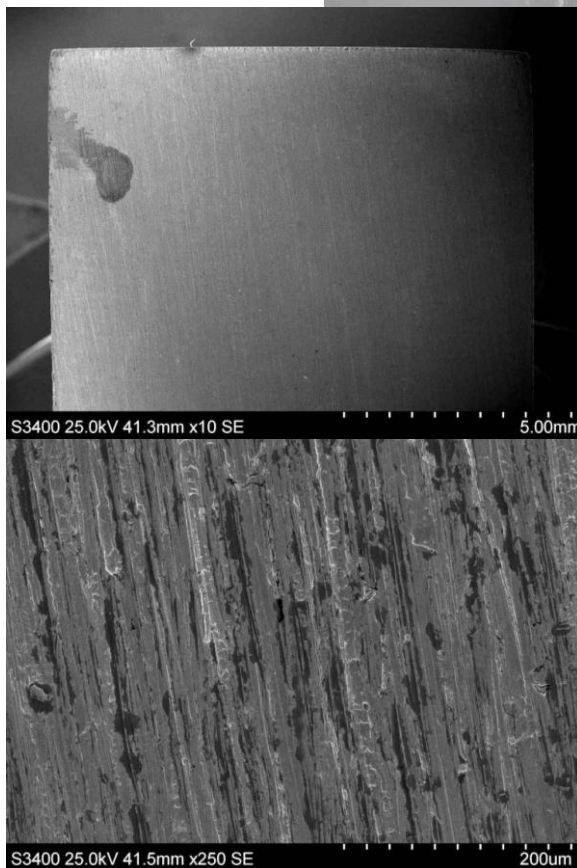
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Figure 2. Photo of the brick coded BTW-5.4 (upper part). SEM images taken prior- (left) and post- (right) the vibration test was conducted.





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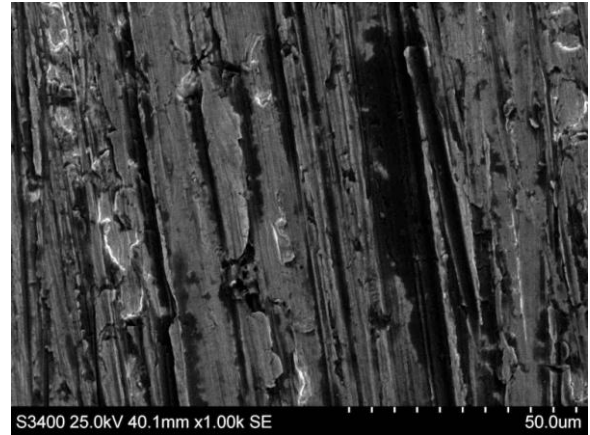
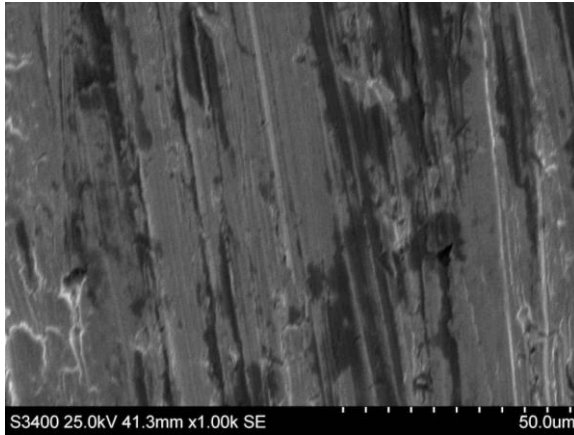


Figure 3. Photo of the brick coded BTW-5.18 (upper part). SEM images taken prior- (left) and post- (right) the vibration test was conducted.



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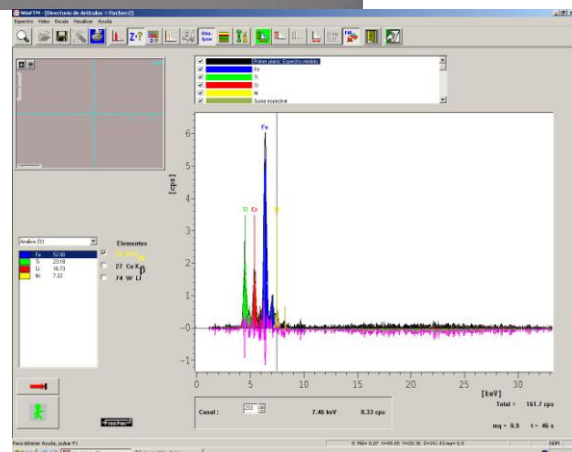
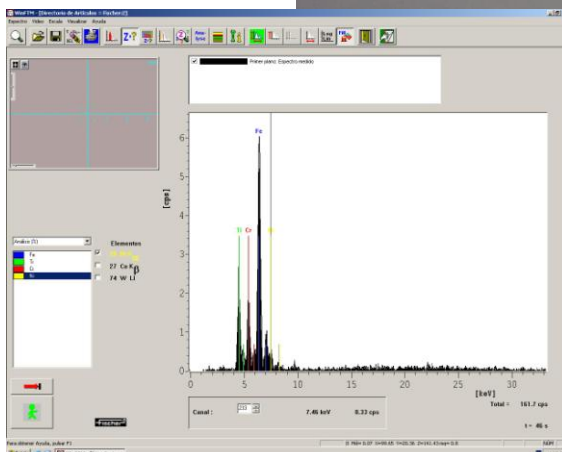
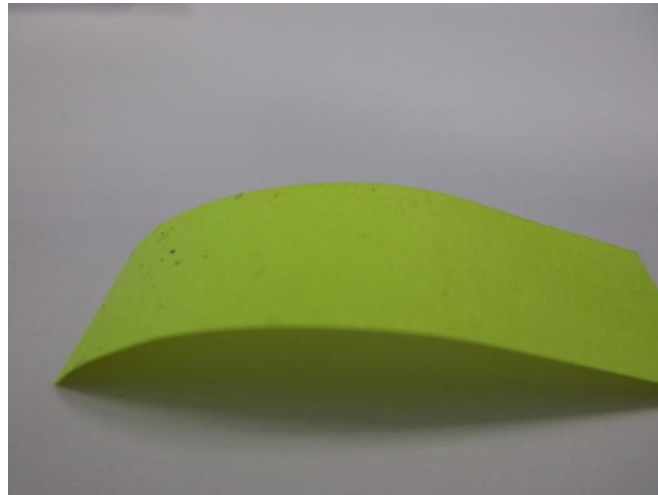
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### 3 EDXRF analysis

An elemental analysis of the grains was performed in order to elucidate if there were stainless steel grains from the base and cover or tungsten grains from the bricks. The analysis was conducted using an Energy Dispersive X-Ray Fluorescence (EDXRF) equipment (FISCHERSCOPE X-RAY SYSTEM XDAL) at the UPV/EHU SGIKER. This system is able to detect elements heavier than Ca and can give a semiquantitative analysis. The X-ray beam was focussed, by using a 100 $\mu$ m collimator, in three different small grains. The recorded spectra are presented in the left-hand side of Figure 4 and the results of the semiquantitative analysis on the right-hand side. Similar results were found for the three grains. The spectra show picks from Fe, Cr and Ni, as well as a Ti pick coming from the paper used as sample holder. The semiquantitative analysis is also similar for the three grains: >50% Fe, 20% Cr and 7% Ni. This elementary analysis indicates that all the analysed grains come from the steel base and cover. No W pick was found in the analysis.





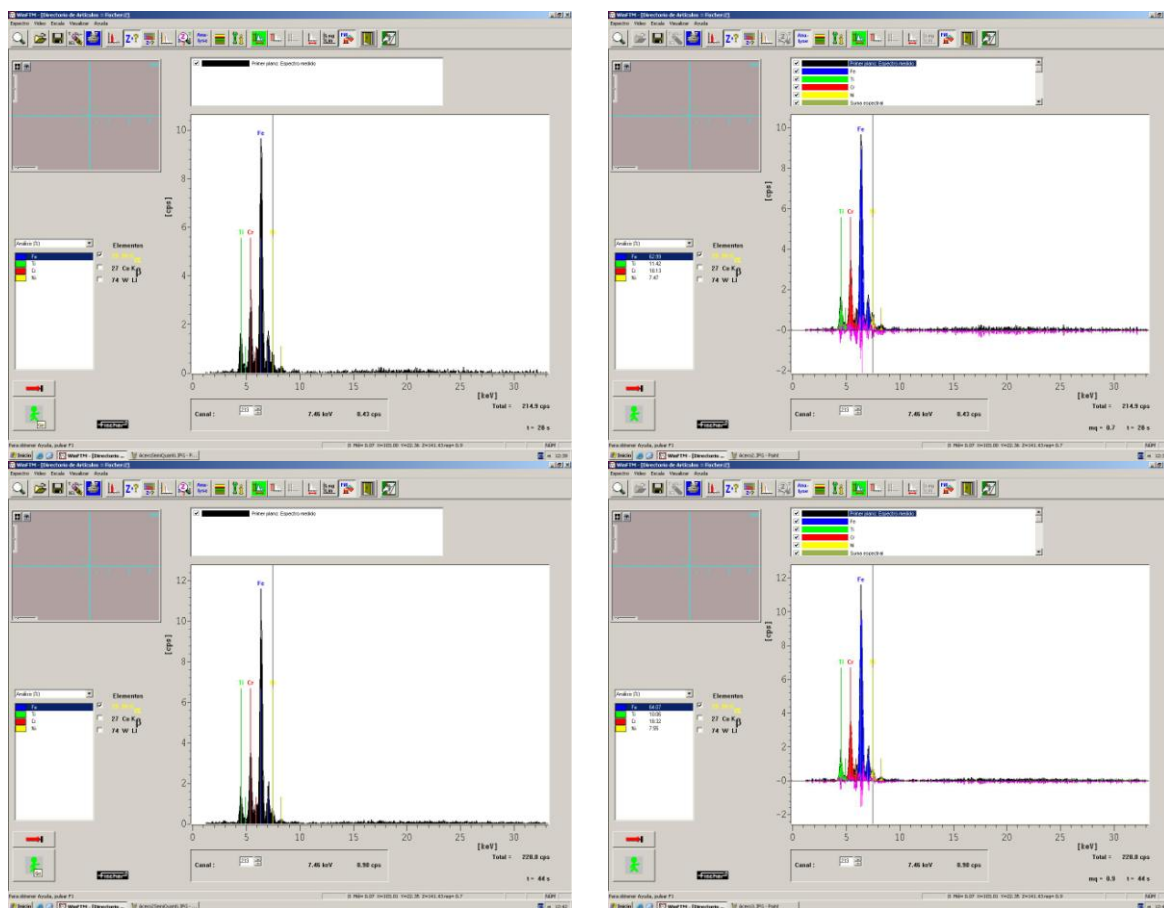


Figure 4. Photo of the collected grains on a yellow paper used to hold them (upper part). EDXRF spectra (left) and semiquantitative analysis (right) performed on three different grains.



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#### 4 CONCLUSIONS

From the comparison of the surface analysis carried out by SEM on the tungsten bricks before and after the vibration tests, the main conclusion is that there is no significant evidence of surface modification and/or degradation due to the vibration test.

On the other hand, the elementary EDXRF analysis indicates that all the examined grains come from the steel base and cover. No W pick was found in the analysis.