

NATIONAL TRANSPORTATION SAFETY BOARD

Office of Research and Engineering
Materials Laboratory Division
Washington, D.C. 20594



May 8, 2019

MATERIALS LABORATORY FACTUAL REPORT

Report No. 19-026

1. ACCIDENT INFORMATION

Place : Eustis, Florida
Date : February 25, 2018
Vehicle : Airborne Windsports Edge XT-912L, N98YW
NTSB No. : ERA18LA089
Investigator : Todd Gunther, AS-ERA

2. COMPONENTS EXAMINED

Remnants of a rear bracing cable assembly

3. DETAILS OF THE EXAMINATION

On February 25, 2018, about 0810 eastern standard time, an Airborne Windsports Edge XT-912L was substantially damaged when it impacted the ground while on approach to Mid Florida Air Service Airport in Eustis, Florida. The pilot was fatally injured. Initial examination of the accident site and wreckage by a Federal Aviation Administration (FAA) inspector revealed that the aircraft had impacted the ground in a nose low, right wing down, attitude. According to FAA airworthiness records, the aircraft was manufactured in 2009. The wreckage was retained for further examination.

Figure 1 shows the remnants of the rear bracing cable assembly, as received. The assembly consisted of a threaded bolt with a nut positioned through a fitting. The bolt shaft also ran through the holes of two clevises, each attached to an incomplete, swaged wire cable fragment. The cable fragment on the left in Figure 1 exhibited features consistent with having been cut, such as shiny V-shaped thread ends with identical termini. The cable fragment on the right in Figure 1 exhibited corrosion, cable pullout and deformation, and irregular termini on each wire. This cable fragment end was examined in more detail, as described below.

Figure 2 shows the terminus of the right cable fragment, as received. The wires generally terminated at the outward swaged end—five of the wires protruded away from the swaged end, and they were deformed downward in Figure 2. Figure 3 shows a closer view of the wire ends at the swaged end. This end exhibited enough corrosion product to cover and obscure the majority of the wire ends. This corrosion product was consistent

with iron oxide (rust), as later confirmed using energy dispersive x-ray spectroscopy (EDS).

This oxide was removed using an ultrasonic bath of acetone followed by a dilute solution with Evapo-Rust.¹ Figure 4 shows the outboard swaged end after this cleaning procedure. The swaged fitting had been deformed, consistent with having been pressed inward from opposite sides. This left the wire bundle arranged in a rounded-I shape. Figure 5 shows a closer view of the wire termini. These ends were consistent with having fractured. The wire ends were generally oriented in random directions, with the exception of the longer wires, shown on the right in Figure 5. These were generally bent outward. Towards the interior of the swaged coupling, the wires generally exhibited a spiral orientation, consistent with wire twisting during cable manufacture.

This swaged cable end was sectioned from the rest of the remnant and was examined using a scanning electron microscope (SEM). An outer and center cluster of the wire fracture surfaces are shown in Figure 6 and Figure 7, respectively. Figure 8 shows a typical cluster of fractured wires. These ends were generally smooth, consistent with the destruction of fracture features from rubbing or oxidation. The sides of several of the wires exhibited crescent-shaped divots and triangular-shaped ends. These features were consistent with material loss from wear during repeated contact with adjacent wires.

The relatively undamaged ends of the wire fracture surfaces (such as the yellow box in Figure 8) were examined more closely. As shown in Figure 9, the end surface features were consistent with elongated dimple rupture, indicative of overstress fracture in shear. Figures 10 and 11 show a closer view of one of the crescent-shaped wire ends. The fracture surface exhibited multiple streaks on the surface, consistent with post fracture smearing. The undamaged area, highlighted in Figure 12, exhibited dimple rupture features, consistent with fracture from tensile overstress.

Figure 13 shows a cluster of wire ends that had narrowed at the ends with some material bulging out the sides. The ends of these wires exhibited a slight bend in one direction. The ends exhibited streaks parallel with the wire longitudinal direction. A closer view of the undamaged portions revealed dimple rupture, as shown in Figure 14. This cluster of wires was consistent with overstress fracture after pinching or cutting.

The cluster of longer wires on the side consistent with wire pullout is illustrated in Figure 15. A pair of the less damaged wires, highlighted by the yellow box in Figure 15, are detailed in Figure 16. The wire fractures exhibited a cone shapes, and the wires had exhibited necking adjacent to the fracture surfaces. Examination of the fracture features revealed dimple rupture, consistent with tensile overstress (see Figure 17).

The fracture surfaces of longer wires shown in Figure 15 were examined and exhibited characteristics typified in Figure 18. The fractures were rough in orientation, with a downward-to-flat angled fracture on one half (to the right in Figure 18), and an outward

¹ Evapo-Rust is a commercially available deoxidizer manufactured by Harris International Laboratories, Inc., headquartered in Springdale, AR.

remnant angled in the opposite direction on the other half (to the left in Figure 18). The fracture features present on these wire ends were consistent with dimple rupture, as typified in Figure 19.

None of the wire ends exhibited fracture features consistent with pre-existing crack propagation. In addition, while there was corrosion present on the wire fracture surfaces and between the wires, there was no indication of any features consistent with fracture from corrosive attack on the wire fractures examined. Dimple rupture was the only fracture feature observed on the fracture wires examined.

The chemical compositions of the wires were inspected using energy dispersive x-ray spectroscopy (EDS). The compositions of the fractured wires were consistent with an austenitic stainless steel. The exterior of the wires exhibited detectable levels of zinc, such as from a coating. As state previously, the corrosion product was found to be consistent with iron oxide. Detectable amounts of zinc were also found in the iron oxide material.

Erik M Mueller
Materials Research Engineer

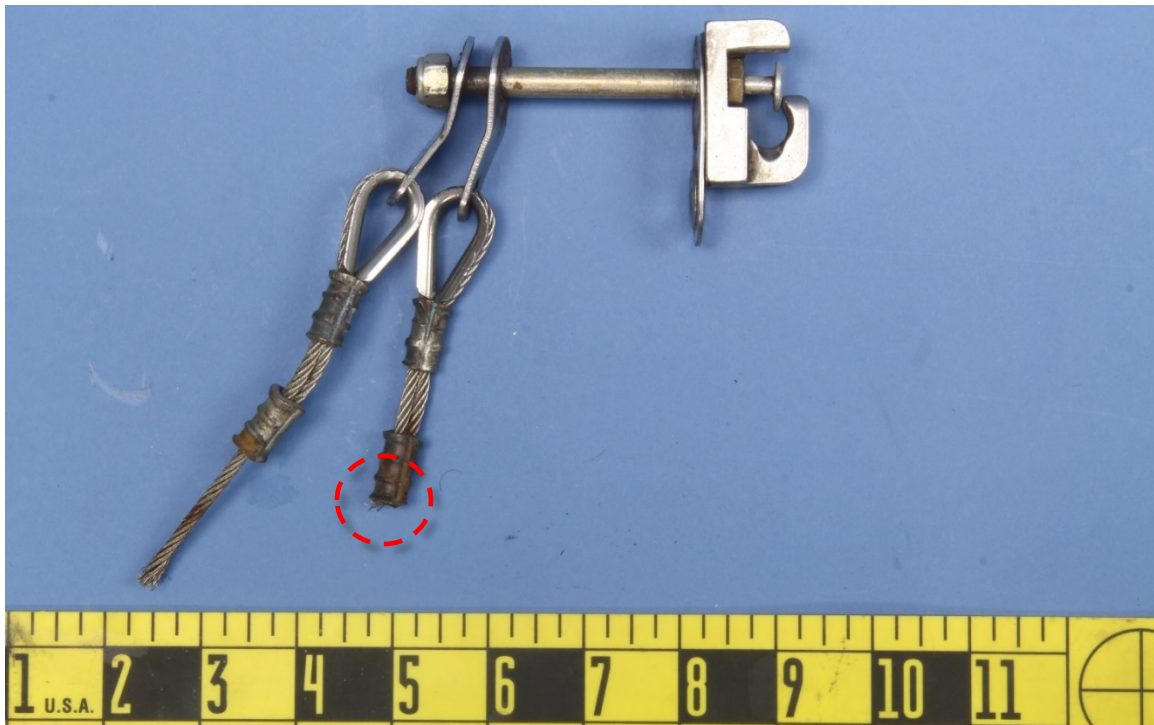


Figure 1 – Remnants of the rear bracing cable assembly, as received. The fracture surface (circled) is shown in Figure 3.



Figure 2 – View of the fractured cable bundle from the crimped fitting, highlighted in Figure 1.



Figure 3 – Closer view of the fractured wires from the cable bundle in Figure 2, as received.



Figure 4 – View of the cable bundle fracture surface, after cleaning to remove corrosion.



Figure 5 – Closer view of the fractured wires of the cable bundle, after cleaning.

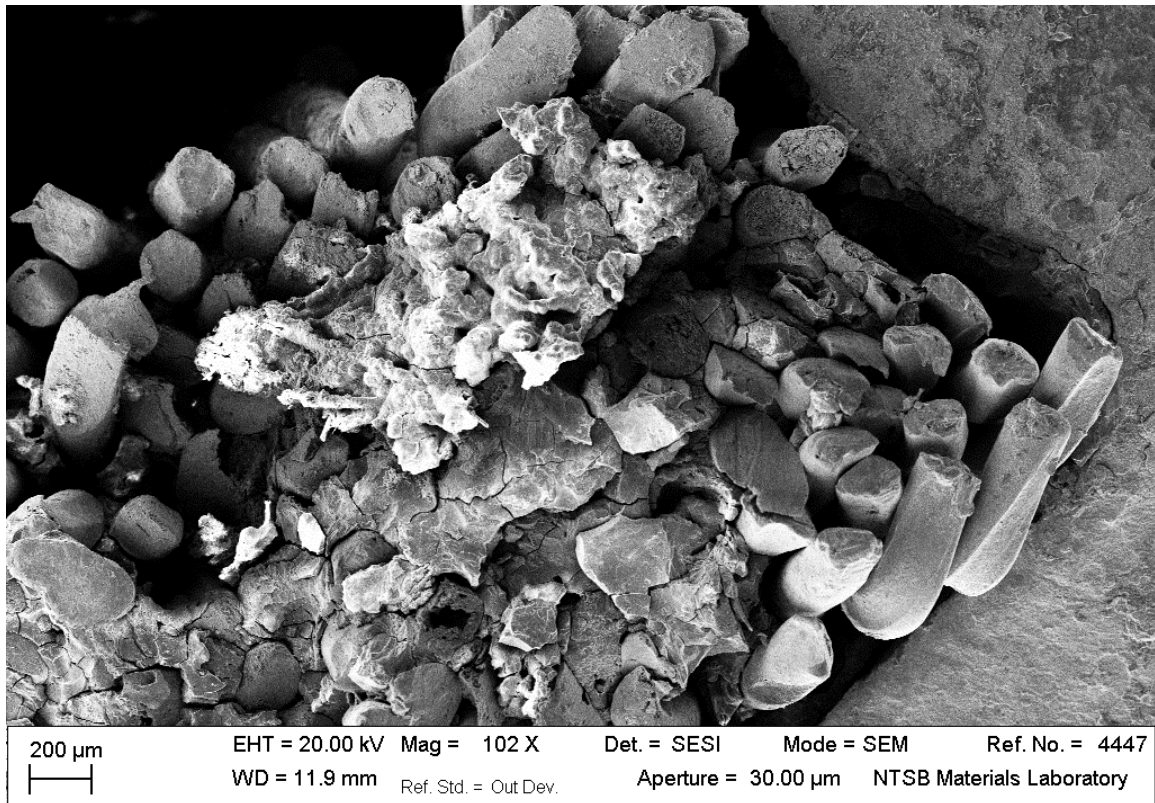


Figure 6 – Secondary electron (SE) micrograph of the wire fractures of the cleaned cable bundle.

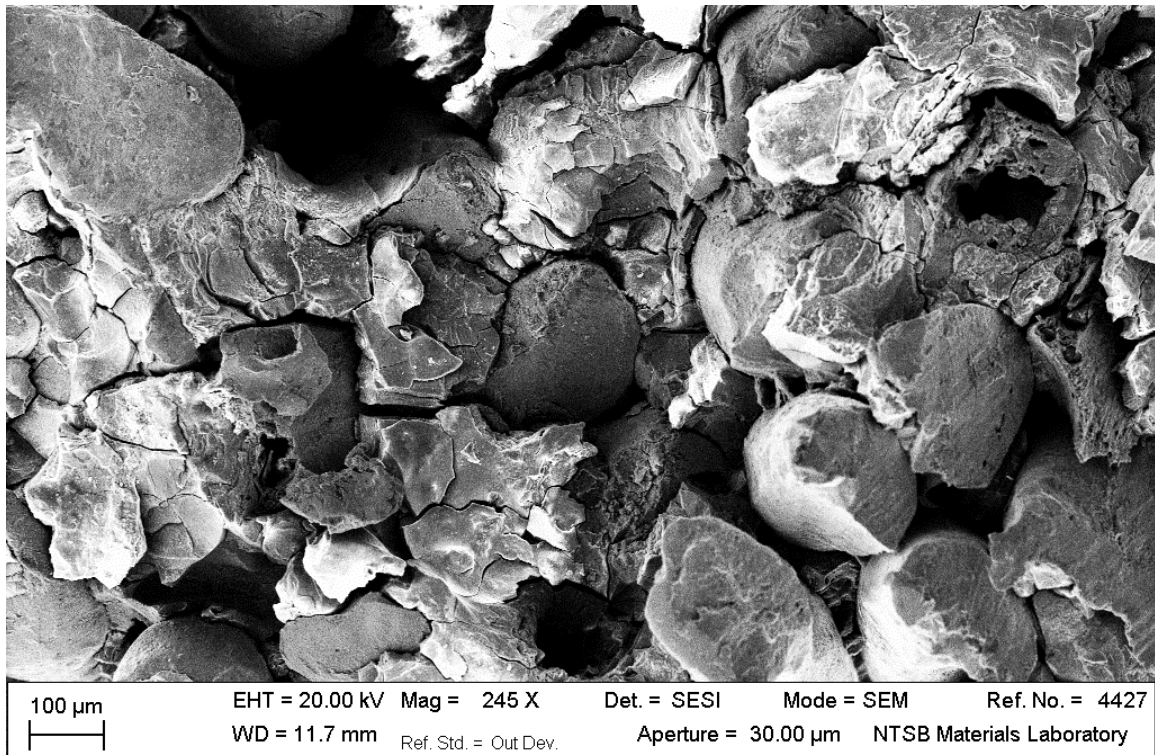


Figure 7 – SE micrograph of a closer view of the center wire fracture surfaces.

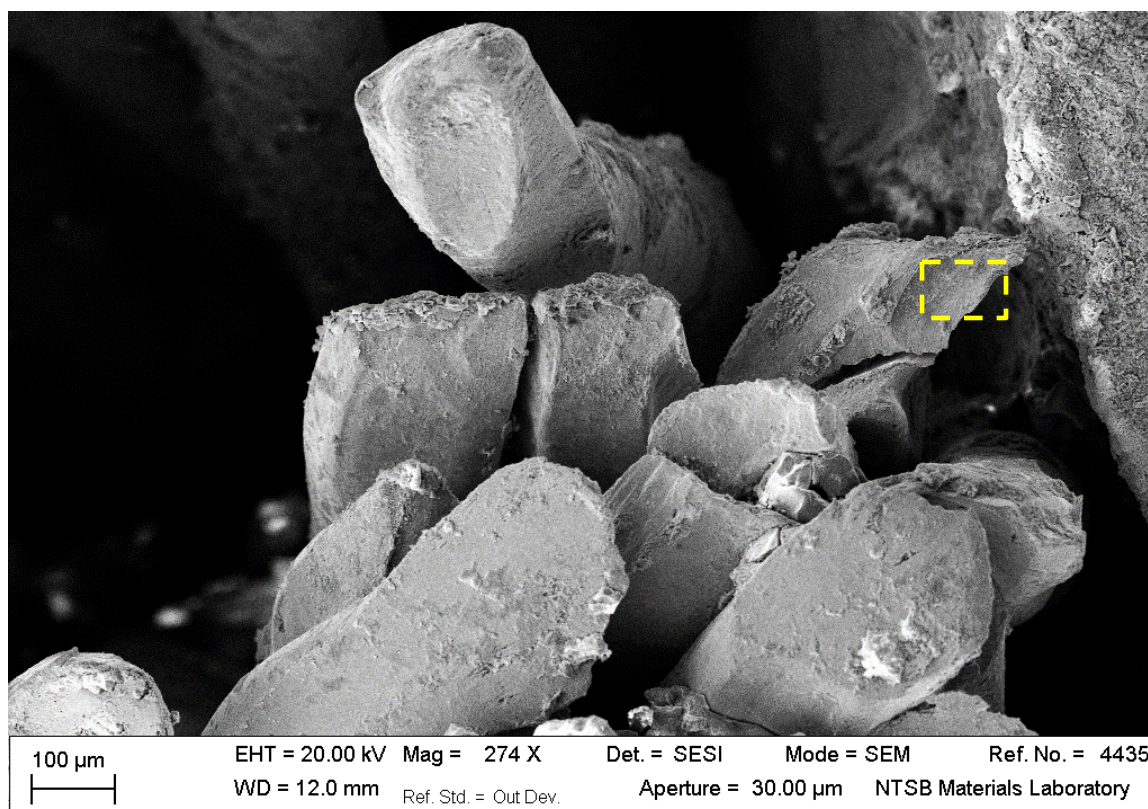


Figure 8 – SE micrograph of several wire fractures, showing pinching and rubbing wear. The boxed area is shown in Figure 9.

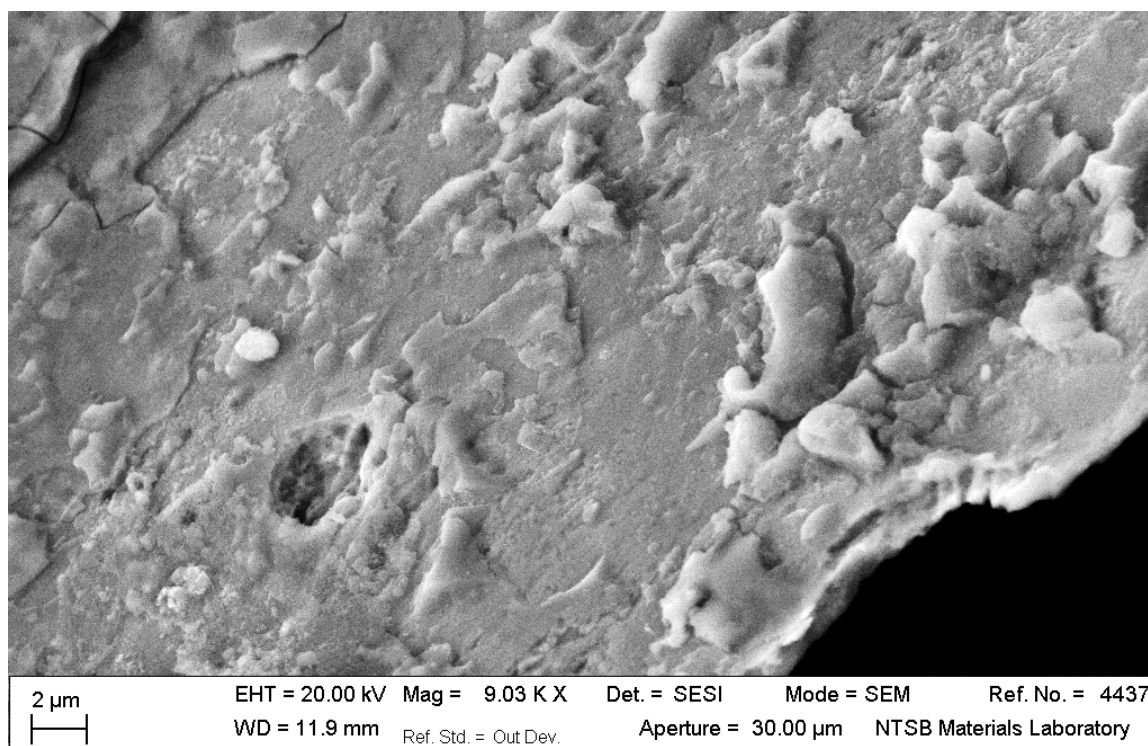


Figure 9 – SE micrograph of one of the above wire fractures, showing dimple rupture.

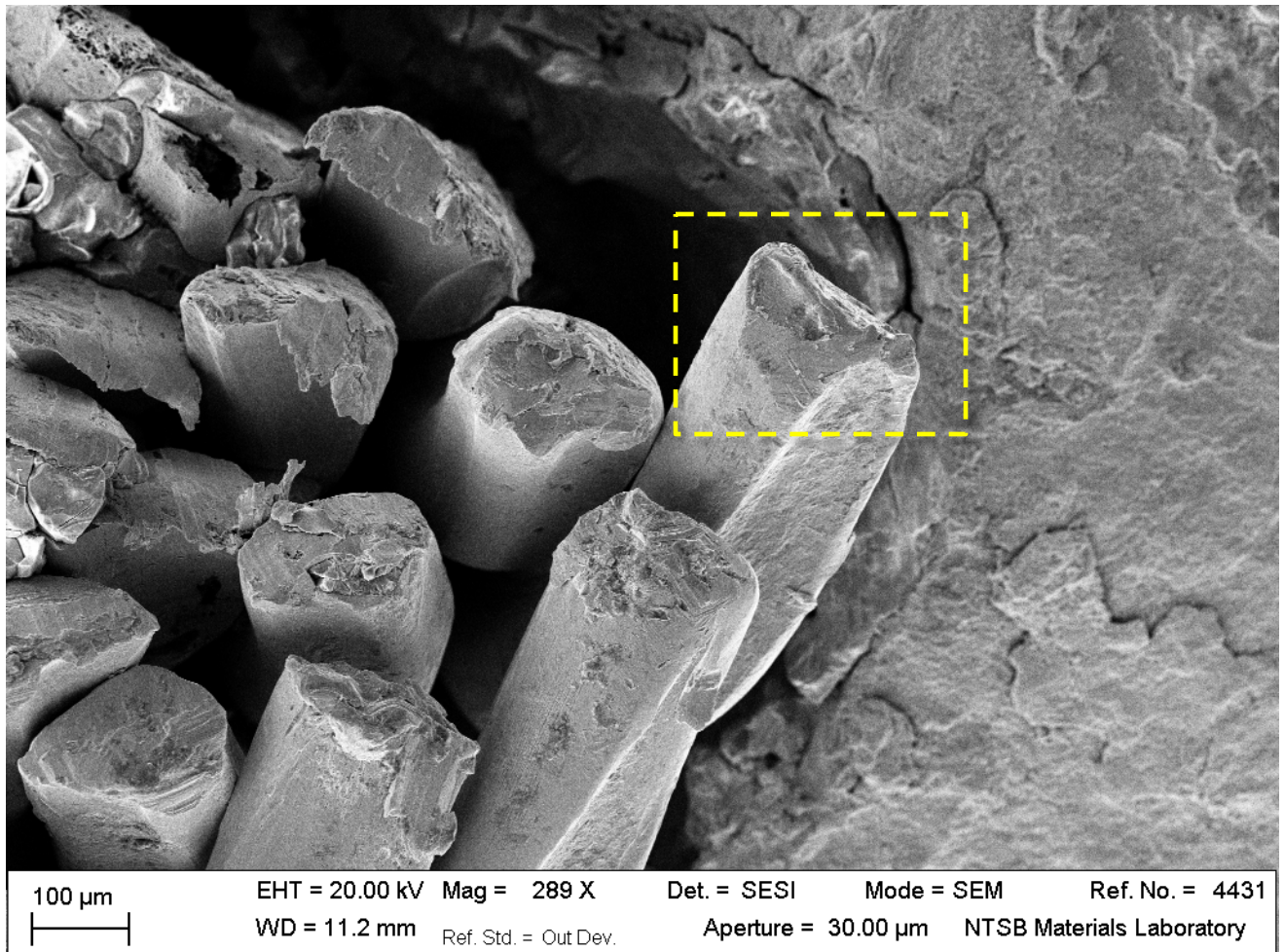


Figure 10 – SE micrograph of the wires to the right in Figure 6, showing rub wear and necked material near the fracture surfaces. The boxed area is shown in Figure 10.

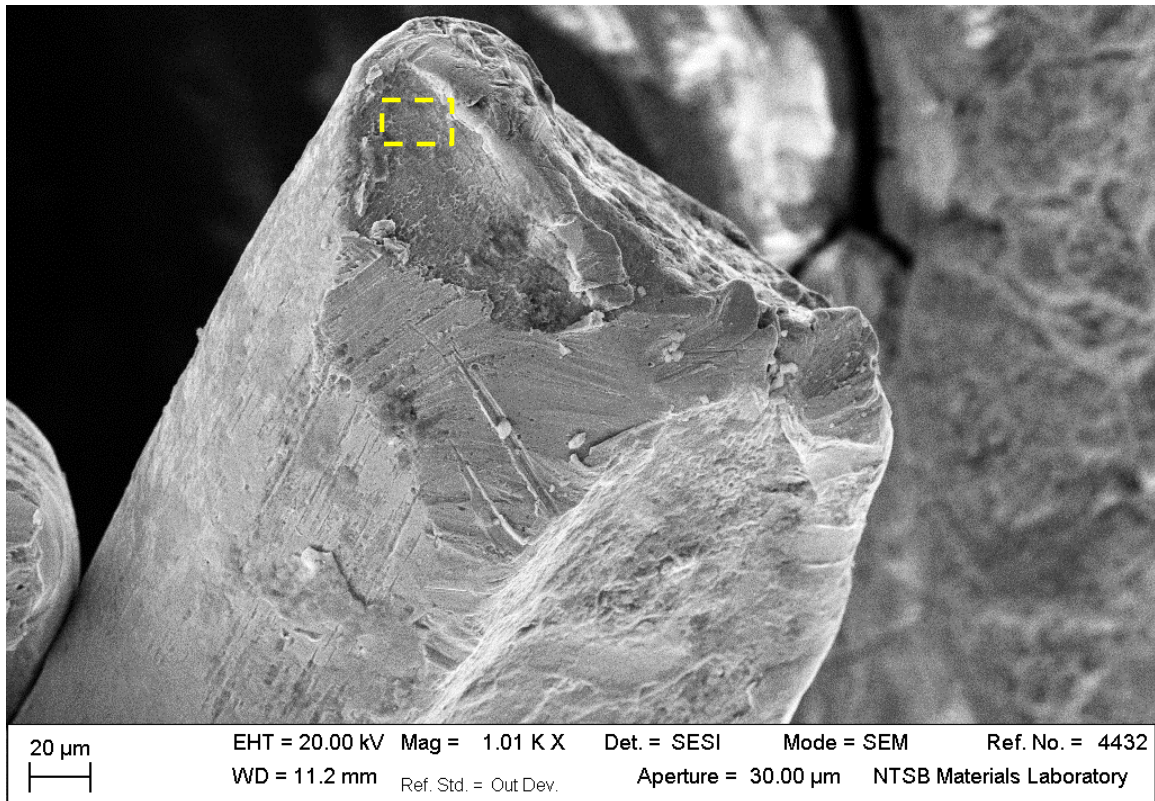


Figure 11 – SE micrograph of the boxed area in Figure 10, showing the wire fracture surface. The boxed area is shown in Figure 12.

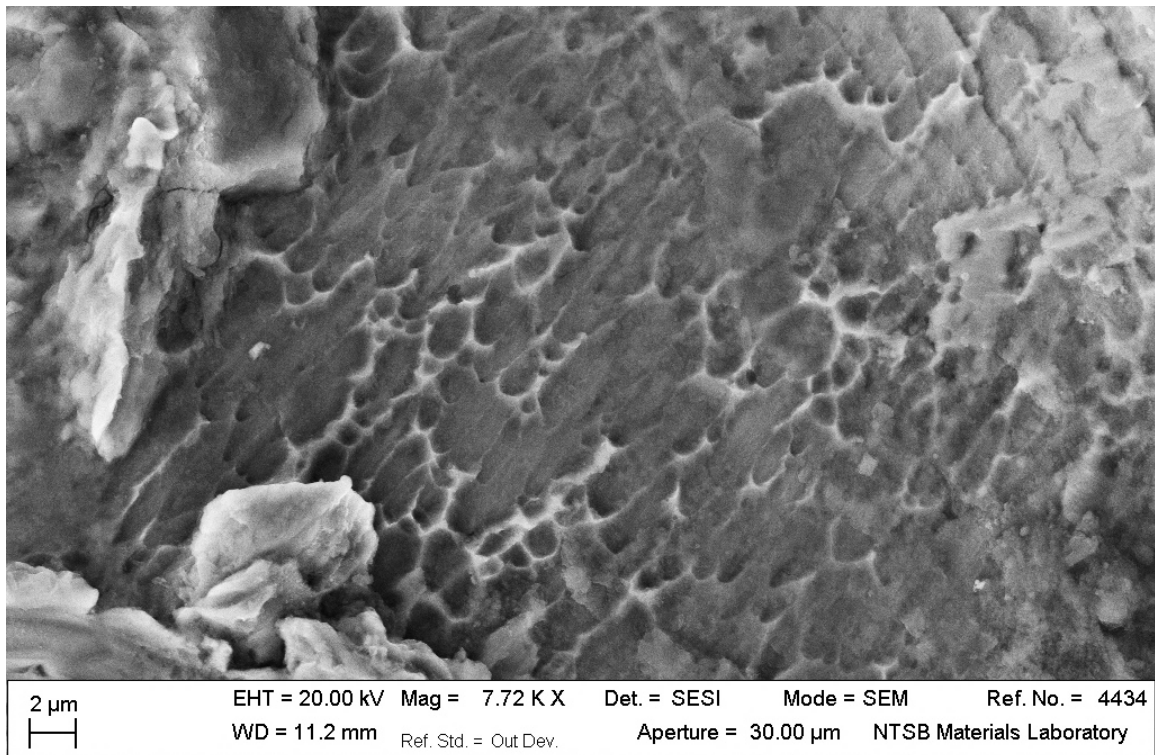


Figure 12 – SE micrograph of the boxed area in Figure 11, showing dimple rupture.

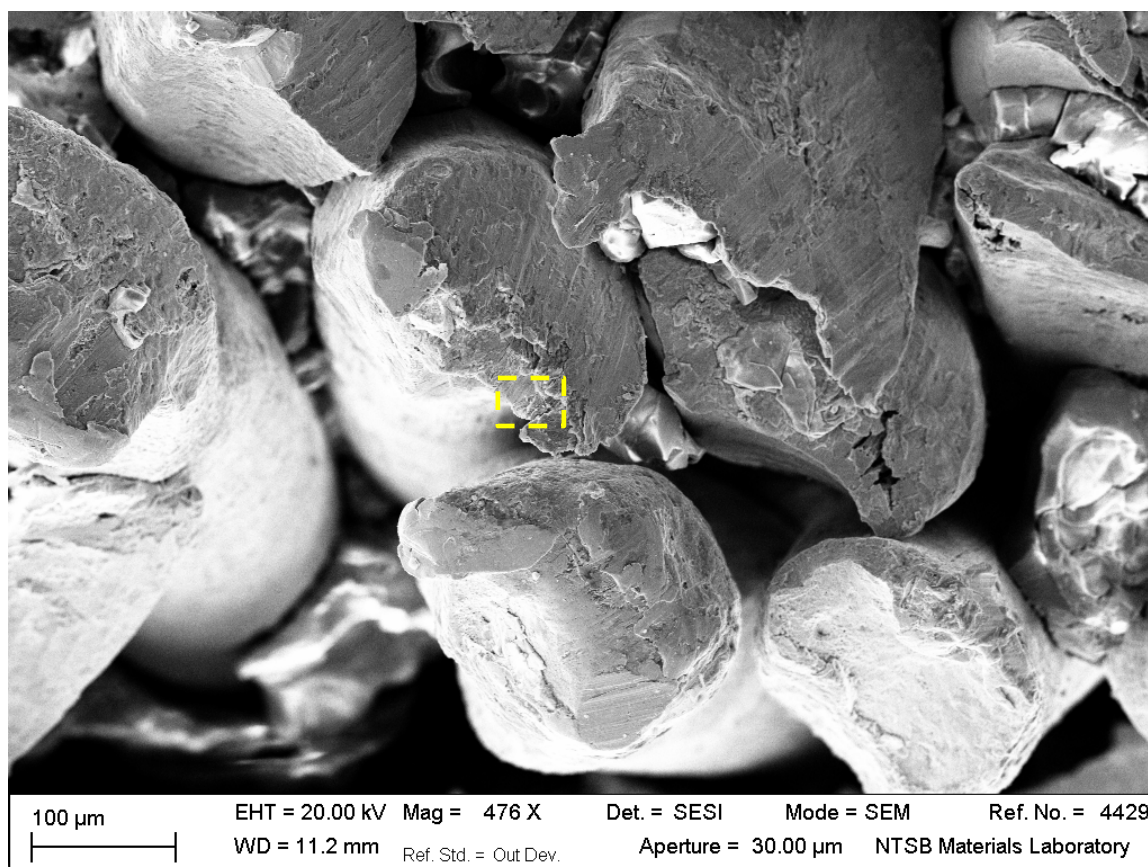


Figure 13 – SE micrograph showing a series of smeared wire fractures. The boxed area is shown in Figure 14.

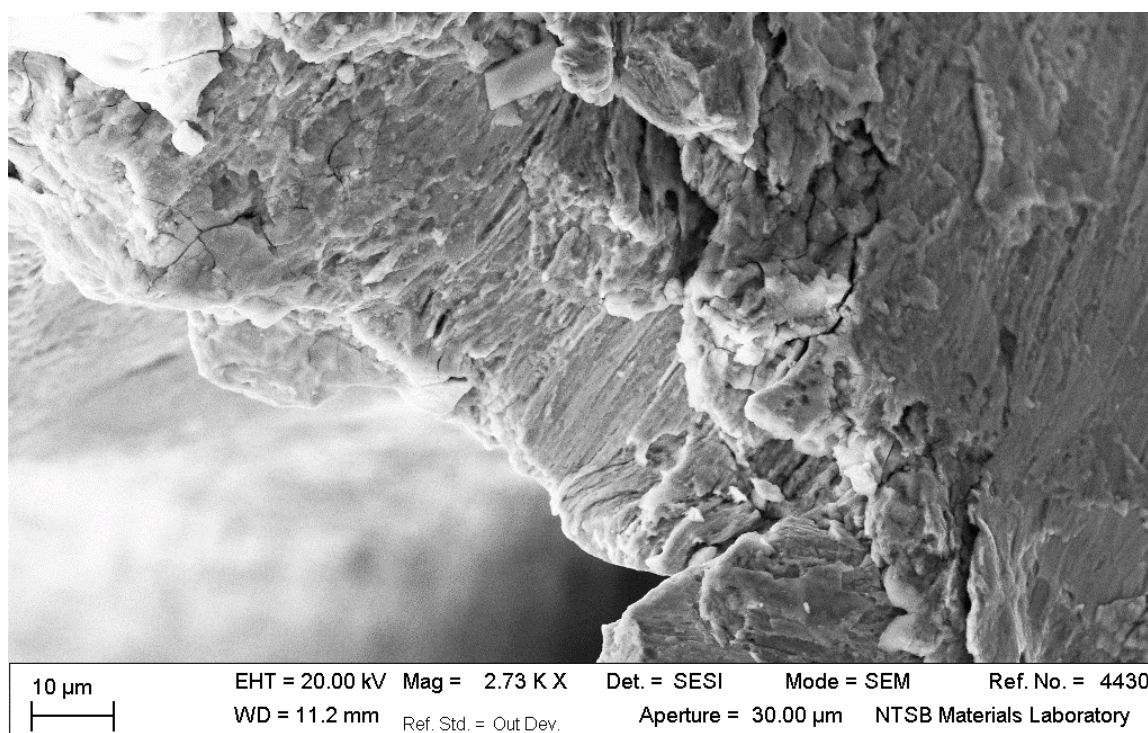


Figure 14 – SE micrograph of the boxed area in Figure 13, showing dimple rupture.

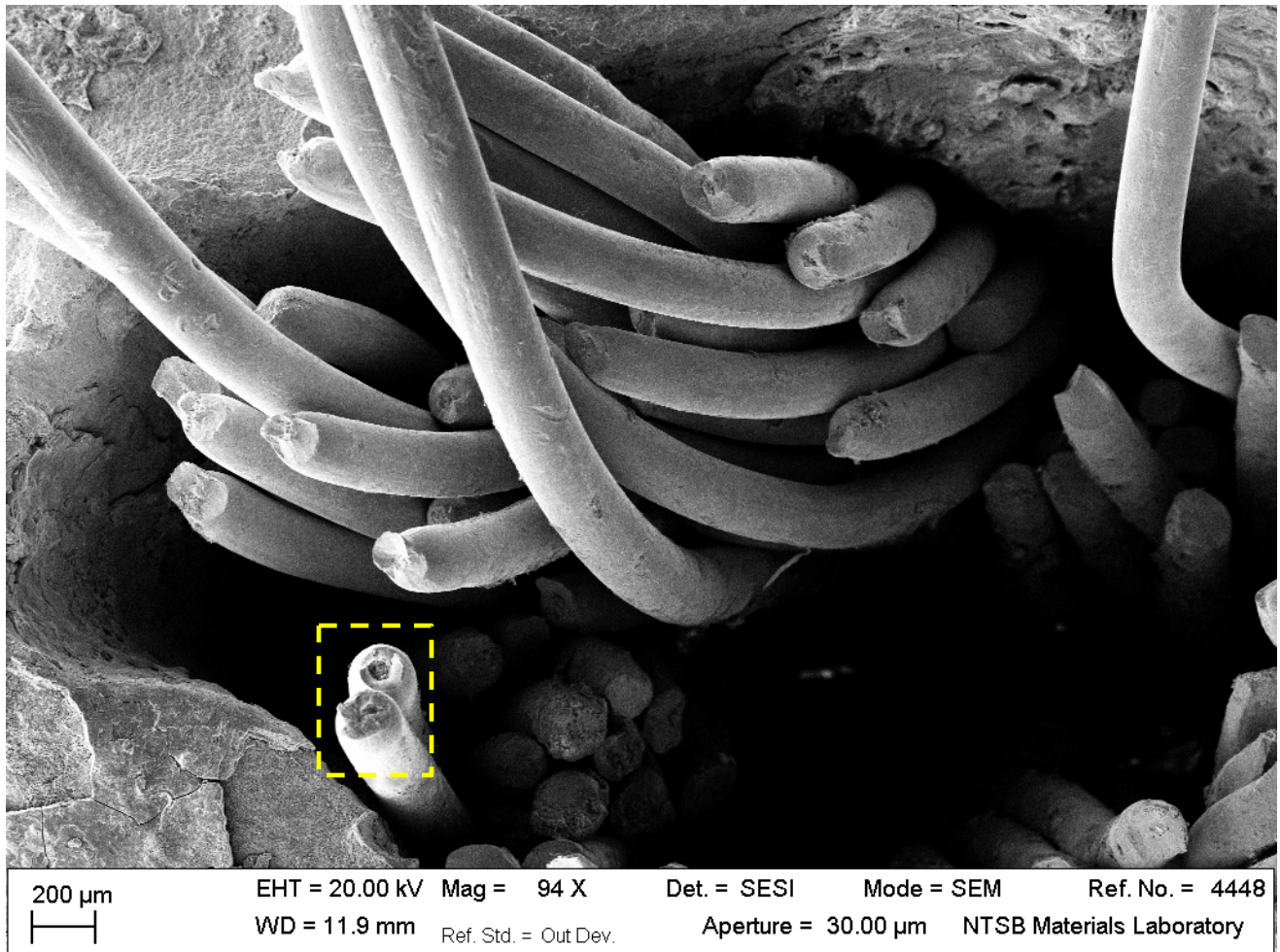


Figure 15 – View of the wire fractures in the upper part of Figure 6, showing cup and cone fractures. The boxed area is shown in Figure 16.

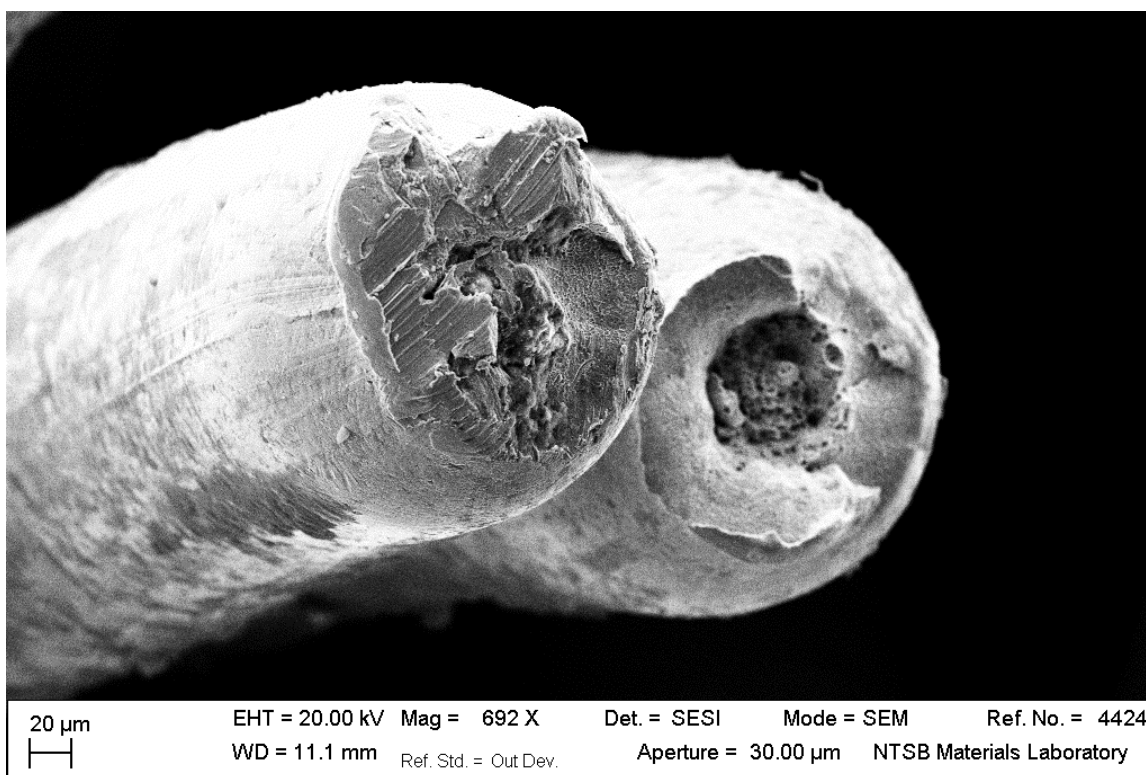


Figure 16 – SE micrograph of the boxed area in Figure 15, showing two necked fractured wires.

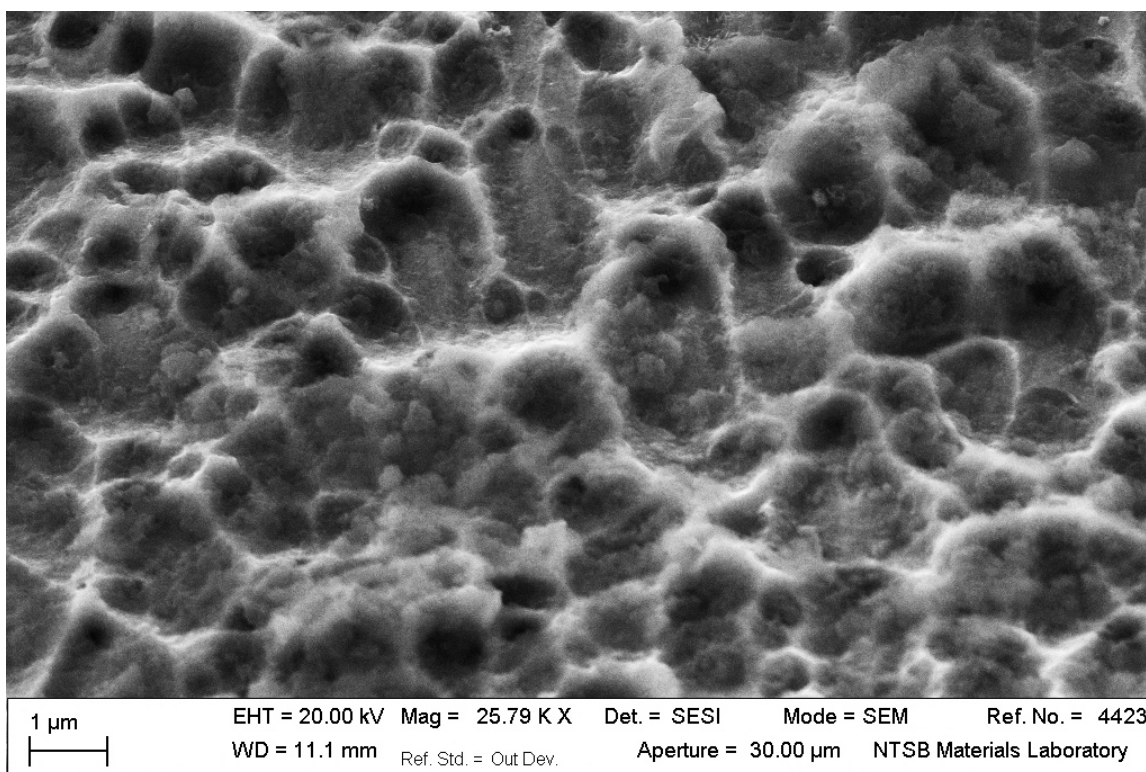


Figure 17 – SE micrograph of the right fracture in Figure 16, showing dimple rupture.

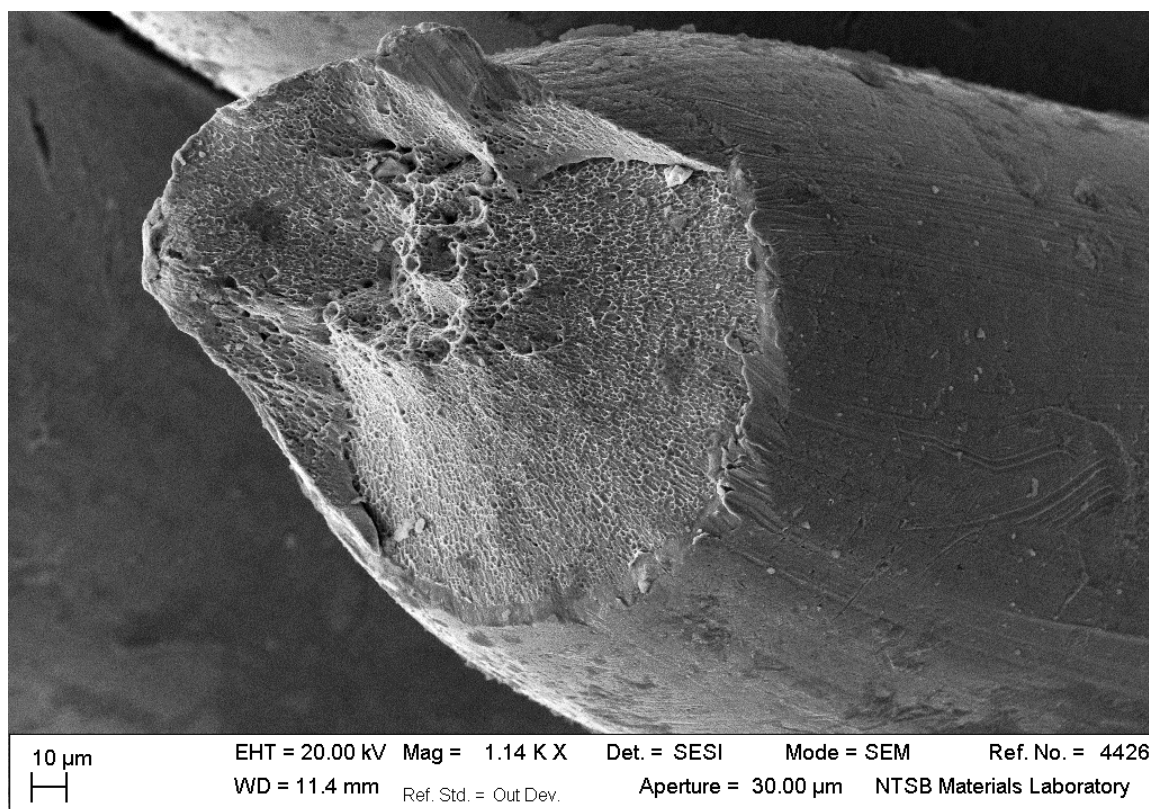


Figure 18 – SE micrograph of a slant wire fracture surface.

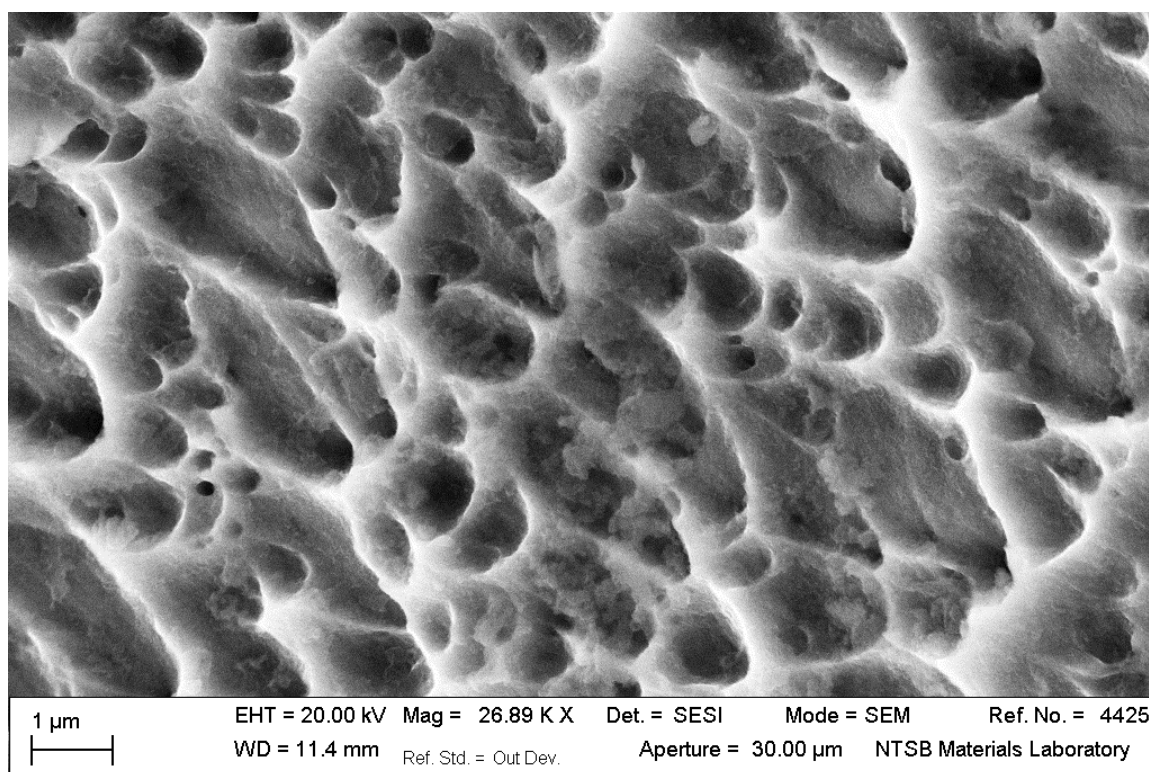


Figure 19 – SE micrograph of a closer view of Figure 18, showing slanted dimple rupture.