XIII. RONCSOLÁSMENTES ANYAGVIZSGÁLÓ KONFERENCIA ÉS KIÁLLÍTÁS

Crack detectability examination of the coating of cooling fins

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Introduction

In this paper an examination is introduced for crack detectability of the coating of cooling fins. The inspected cooling fins are coated with thin Ni-layer. The cracking of this layer can be caused by the lifetime testing process, and this can lead to unexpected failure of our structure *(Figure 1*). Due to this cracking phenomenon the cooling fins must be inspected with an appropriate method to indicate the discontinuities.
Three different type of methods were used during the examination, and the purpose of this work was to select a reproductive, fast and reliable NDT (Non Destructive Testing) method for the crack detection.
The used methods:

- Visual Tetsing (VT)
- Scanning Electron Microscopy (SEM)
- Penetration Test (PT)

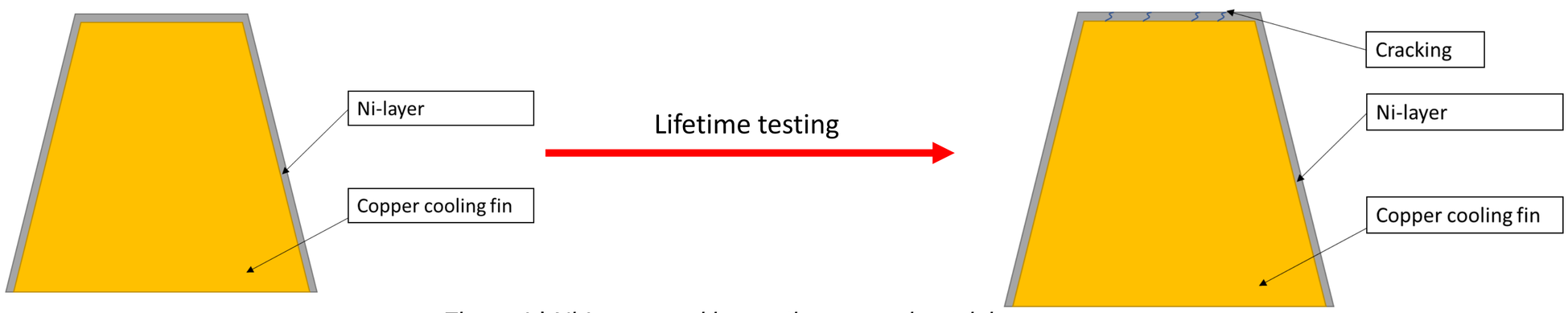

Figure 1 | Ni-Layer cracking on the copper heatsink

Methods and results:

Visual Testing (VT)

VT was performed without sample preparation with light microscope with min. 50x magnification to inspect the surface of the fin coating. It can be assumed that the size of the cracks is way under the size of the surface roughness, so the cracks cannot be detected with this technique. Other direct visual inspection techniques cannot be used due to the size of the cracks.

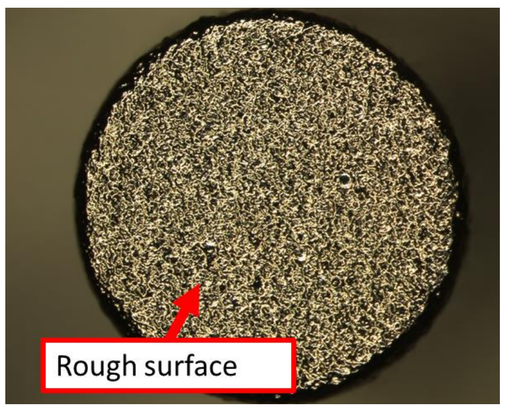

Figure 2 | 50x magn. image of the coating surface

Scanning electron microscopy (SEM)

The inspection was done with HDBSD detector, 20 kV acceleration voltage, and 200 pA probe current. With SEM technique the cracking of the Ni-layer is visible. This method needs long inspection time due to the vacuuming of the chamber. Samples do not need any special preparation process. The thickness of the cracks can be easily measured with this method. The detected cracks has a width in ca. 4-5 µm.

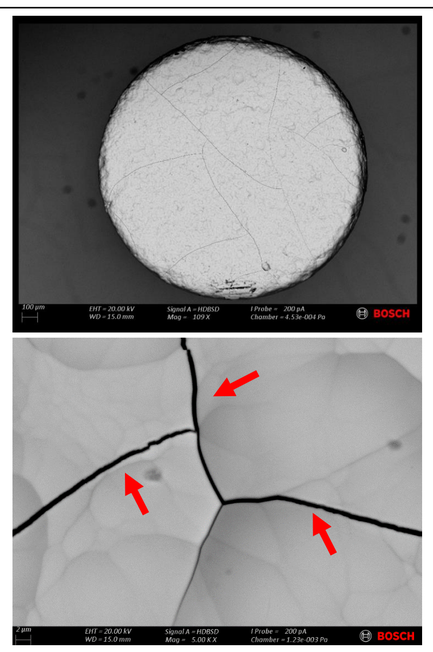

Figure 3 | SEM images of the cracking

Penetration test (PT)

Penetration test was performed with two different sensitivity level UV-penetrant: one Level 2 and one Level 4 sensitivity according to ISO 3452-2. Penetration time was 5 min in case of both penetrant liquid, and the cleaning process were performed with clean water. For the examination of the surface after the penetration process, UV-light microscope was used with min. 50x magnification. The results showed that the Level 2 sensitivity penetrant had better wetting property on the sample than the Level 4 sensitivity penetrant. With the Level 2 sensitivity level penetrant the cracks are visible on the surface of the cooling fin *(Figure 4).* The thickness of the indication can also be measured with this technique (4-5 µm crack thickness was measured).

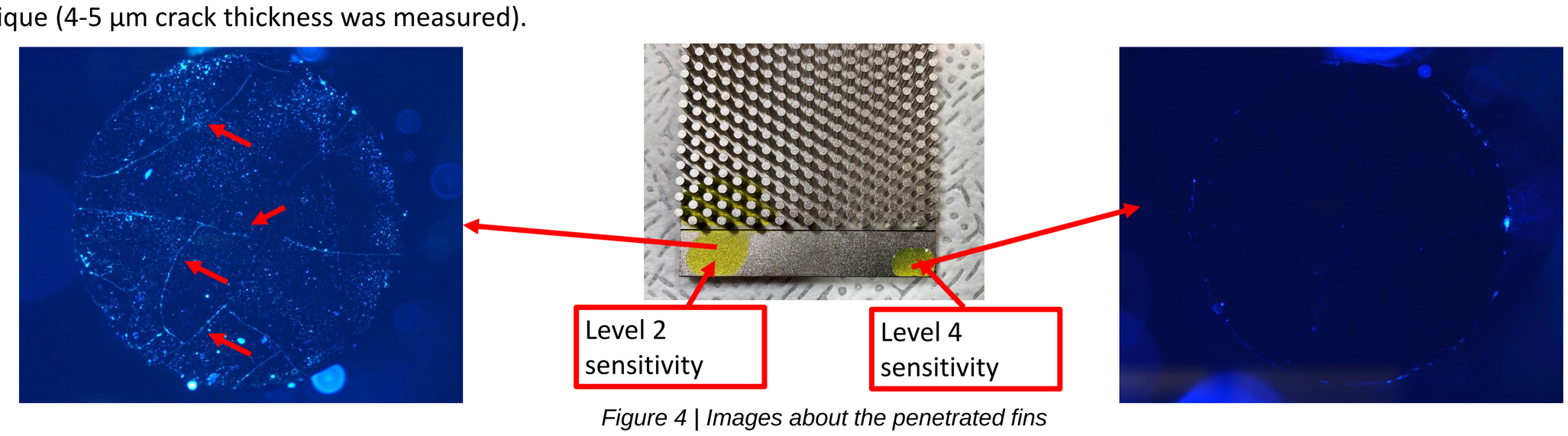

Figure 4 | Images about the penetrated fins

Summary and conclusion:

The SEM technique and PT was appropriate method to indicate the cracks and measure their thickness. The same information can be achieved with the two techniques, but the PT proved to be usable method with better examination time. It is easy to see, that VT is not suitable for detecting cracks of such a small size. It can also be concluded that special attention must be paid to the selection of the test liquid when using PT.