Functional Materials

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Characterisation of single stone impact defects of anticorrosive coated automotive steel plates

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Corrosion protection is an important attribute of the quality of premium cars. To satisfy the customer and to guarantee the quality standardised testing of parts and prototypes are applied by the automotive industry. However, results of accelerating corrosion tests differ from corrosion data of field components. Additionally, results of corrosion issues in a late stage of the development process are difficult to handle for the production processes. Due to common problems it is necessary to detect stone chipping areas in an early stage of development due to a computerized simulation of stone chipping. The following work aims to stone impact and the corrosion progress starting from the stone chipping defect [1]. Induced damages of the coating system and the corrosion propagation were analysed using Pulsed-Phase-Thermography (PPT). After analysing results were correlated and verified with destructive analyses [2]. 3D surface measurement techniques [3] and destructive measurements were used to get information about the corrosion depth and the material removal behaviour of automotive parts. In a first step, steel plate samples in an as delivered condition from different types and combinations of anorganic and organic anticorrosion coatings were characterised on their surfaces and cross sections. These references were shot at from a mono stone impact test facility with defined profiles and weight of the impactor with varied velocity and angle. These impact defects were characterised with various methods. To gather a 3D-information of the defect surface measurements were made with an Infinite Focus Microscope (IFM) [3]. The IFM enables the measurement of three dimensional structures and volumes (see figure 1) using real colour information. Next the non-conductive surfaces were analysed inside an Environmental Electron Microscope (ESEM) using Energy Dispersive X-Ray-Spectrometry (EDXS) (see figure 2). Afterwards cross sections were made to investigate possible destruction or/and delamination of layers with ESEM/EDXS (see figure 3). Parallel different standardised corrosion tests were started and these specimens were characterised in the same way after the test cycles. To avoid mechanical or chemical influence on the corroded defects, additionally Focused Ion Beam (FIB) Slice & View technique was used (see figure 4).

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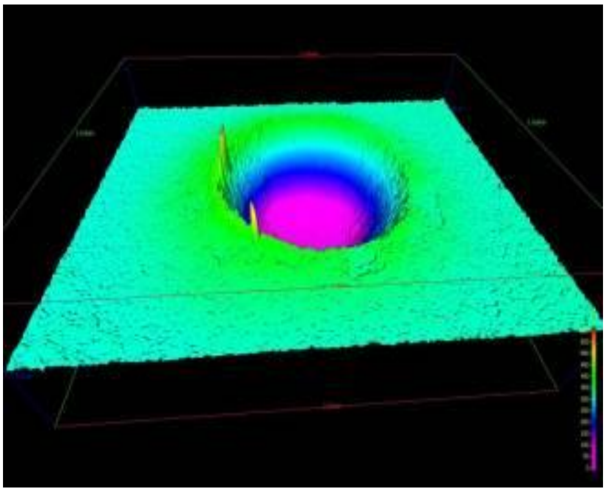

Figure 1. (left); IFM 3D surface model of a stone impact defect as false colour image

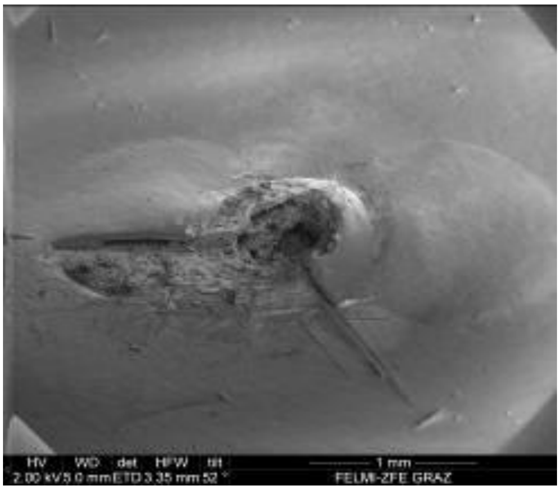

Figure 2. (right); ESEM SE image of the surface of a coated steel plate with a stone impact defect

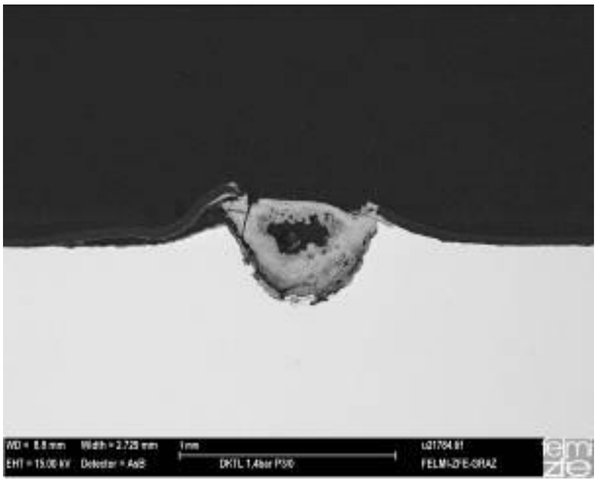

Figure 3. (left); SEM BSE image of a cross section through a stone chipping defect exposed in an accelerated corrosion test

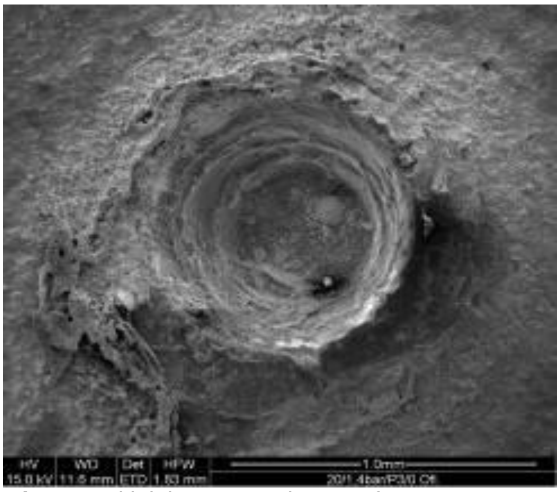

Figure 4. (right); SEM SE image of a FIB-cut through a stone chipping defect exposed in an accelerated corrosion test [5]