Microstructural Investigations using Correlative Microscopy in Materials Analysis

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Austempered Ductile Iron (ADI) excels through strength, wear resistance and toughness – characteristics that make ADI the material of choice for use in combustion engines and gear box components. This means that safety aspects are also involved in addition to purely functional aspects. For this reason, changes in the ADI production process need to be monitored with respect to the material´s characteristics and must be optimized systematically. For the micro- and nanoscopic analysis of the structure and precipitations, scientists typically use both light and electron microscopes. To date, however, there has been no possibility of relocating regions of interest without error when transferring the sample from the light to the electron microscope or vice versa. We show results using a new interface for correlative microscopy in materials analysis which offers an easy-to-use solution, allowing seamless integration of these two complementary technologies for the first time.

The current investigations were done on a ZEISS Axio Imager.M1 light microscope with motorized stage, SUPRA 55 VP Field Emission-SEM (FE-SEM) equipped with an AsB detector, and Bruker Quantax 200 EDS detectors.

Supporting the tribological characterization the main investigation task was an exact description, including elemental analysis, of the materials microstructure. This was, however, only possible with the help of correlative microscopy, because the (hard) precipitates allowed a systematic investigation in the scanning electron microscope(SEM) after being examined in the light microscope only in case of a precise relocation. In addition, the task became more complicated by the fact that it was only possible to detect the precipitates in the SEM with the backscatter electron detector (e.g. AsB).The identification of the chemical composition of precipitates is possible only by EDS. Thus, the exact relocation of the region of interest (ROI) – in order to avoid time consuming searches – is of great importance. Shuttle & Find, the first-of-its-kind correlative microscopy solution (Carl Zeiss) fulfills exactly these application requirements and allows micron-precise relocation of the ROI on metallographic samples even at high magnifications in both light and electron microscopes, making subsequent EDS in a SEM a matter of routine(Figure 1).

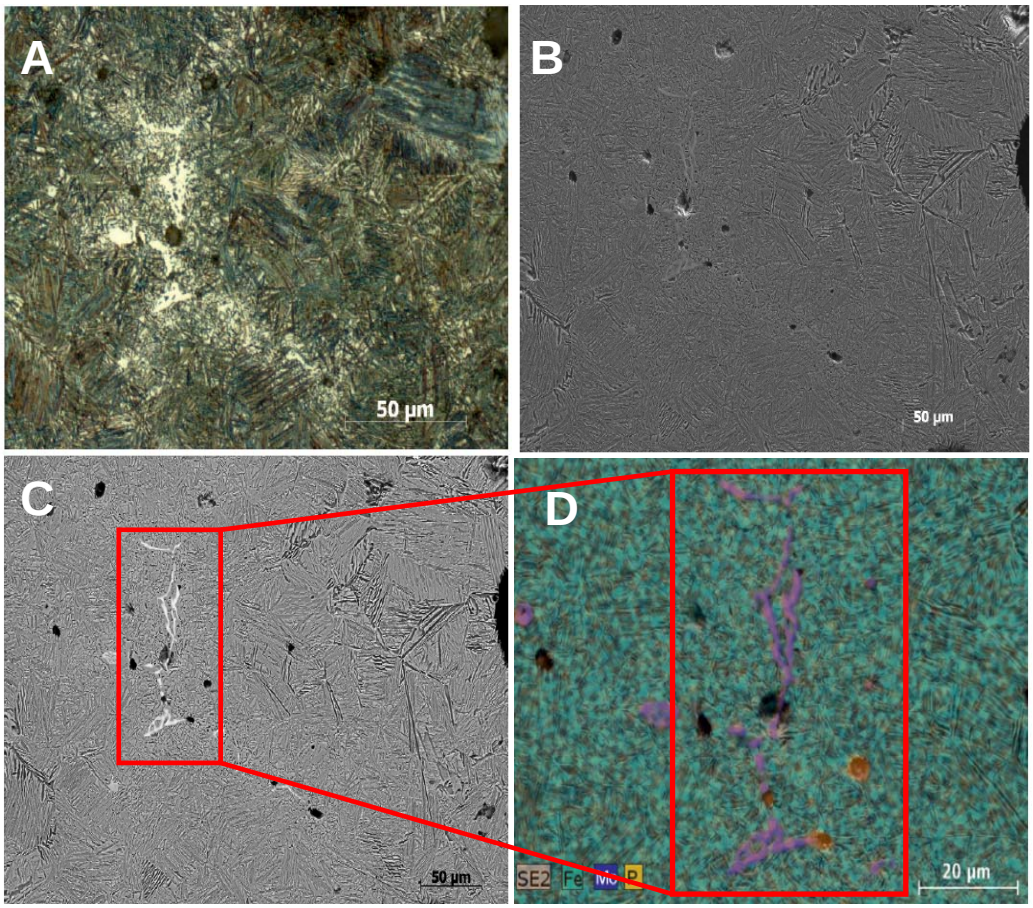

Figure 1. A)Light microscope image in dark field mode displays natural colors not visible in SEM. B) Secondary Electron detector image from SEM. C) Backscatter electron detector image of the same Region of Interest, microstructure more visible compared to SE image. D) EDS map of the same area for the elements Mo ,Fe and P.