LUXOR

TESTIMONIAL

ArcelorMittal

LUXOR AT ARCELOR MITTAL STEELWORKS IN BELGIUM

In May 2023, ArcelorMittal in Belgium replaced its old sputter coater with a brand-new LUXOR^{Au} gold coater. At first sight, one would not expect a steel plant lab to need metal coating as a sample preparation technique for SEM. This testimonial explains the usefulness of the LUXOR^{Au} gold coater to obtain higher image resolution in SEM imaging in the metal lab, while at the same time increasing safety for the SEM column and operator.

ArcelorMittal Gent is a Belgian steel company, founded in 1962 and located near Zelzate in Belgium. Today the company produces about 5 million tons of flat steel per year, with the automotive industry being an important market. Flat steel is produced as hot rolled, cold rolled, galvanized steel and plastic-coated steel. ArcelorMittal produces steel from ore and has coking plants, sinter plants (blast furnace raw material production), blast furnaces, zinc galvanisation and organic coating lines, and hot and cold rolling facilities.

WHY USE A SEM COATER FOR STEEL APPLICATIONS?

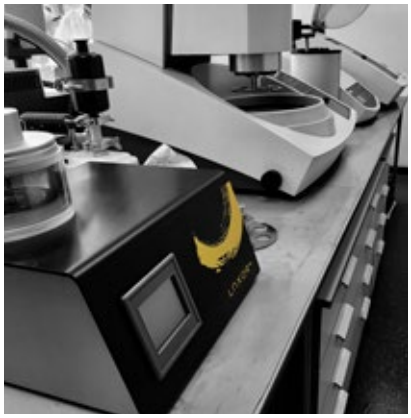
At first sight, one would not expect a steel plant lab to need metal coating as a sample preparation technique for SEM. Steel is a good conductor of heat and electricity, so charging in the electron beam of the microscope should not be an issue.

Frank Medina-Diaz, Head Laboratory Micro-Research and Defectuology (Department Quality & Products) explains:

"You would indeed think that for research in the steel industry using SEM, metal coating is not needed. Our activities in the lab broadly fall under the broad heading of defectuology. On the one hand, that involves investigation of quality problems in and around our own production facilities, which are outside the standard QC work carried out at ArcelorMittal. Think, for example, of a one-off or rare and unprecedented corrosion phenomenon in our manufacturing process, traces of an "exotic" contaminant in a finished product, or a complaint from an end customer about a visual problem with a coating applied to our products. The parts we receive in the lab are usually prepared using the universal "sample preparation chain" cutting - mounting (or embedding) - polishing. During the mounting step conductive resins can be used, but practical experience shows us that the non-conductive variants are easier to utilize and often also provide more accurate information in the SEM. Provided, of course, that they are being coated.

To investigate the layer thickness of organic coatings, we are even going to coat some samples 2 times. A first gold coating is applied to the surface of the sample after the cutting step, and the second gold coating is applied after the polishing step. As a result, the thickness of the organic coating between the metal sample and the first gold coating is clearly visible. Should we not apply the first gold coating, the contrast between the organic coating and the resin would be too small. So, in this case, we use the first coating step to visually determine coating thickness, and the second to prevent charging of the resin."

The LUXOR^{Au} metal coater at the end of the cutting – mounting – polishing chain in the sample preparation lab



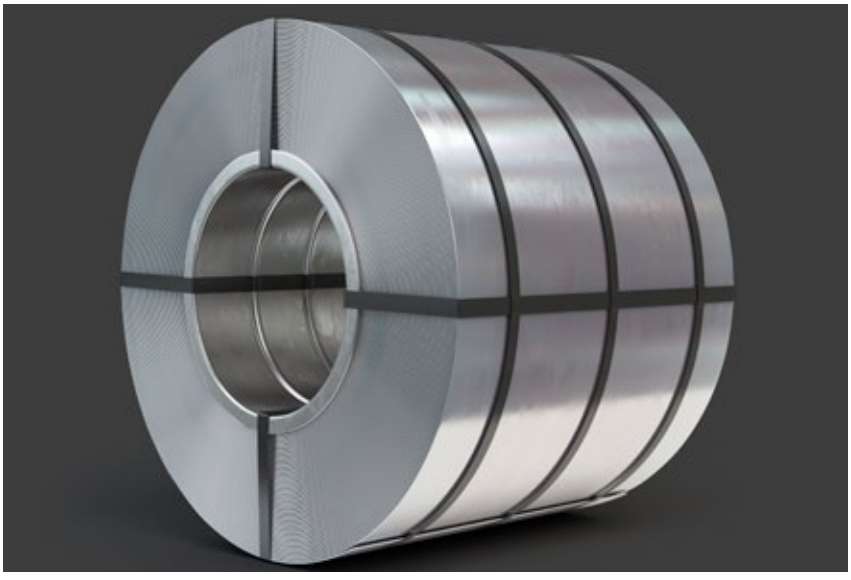
"MORE ACCURATE INFORMATION IN THE SEM"

Frank Medina-Diaz from ArcelorMittal Defectuology lab with Jan De Munck from LUXOR at the LUXOR^{Au} coater

EXAMPLE OF DETERMINING THE THICKNESS AND HOMOGENEITY OF AN ORGANIC COATING ON METAL STRIPS USED TO HOLD ROLLS OF METAL SHEET TOGETHER

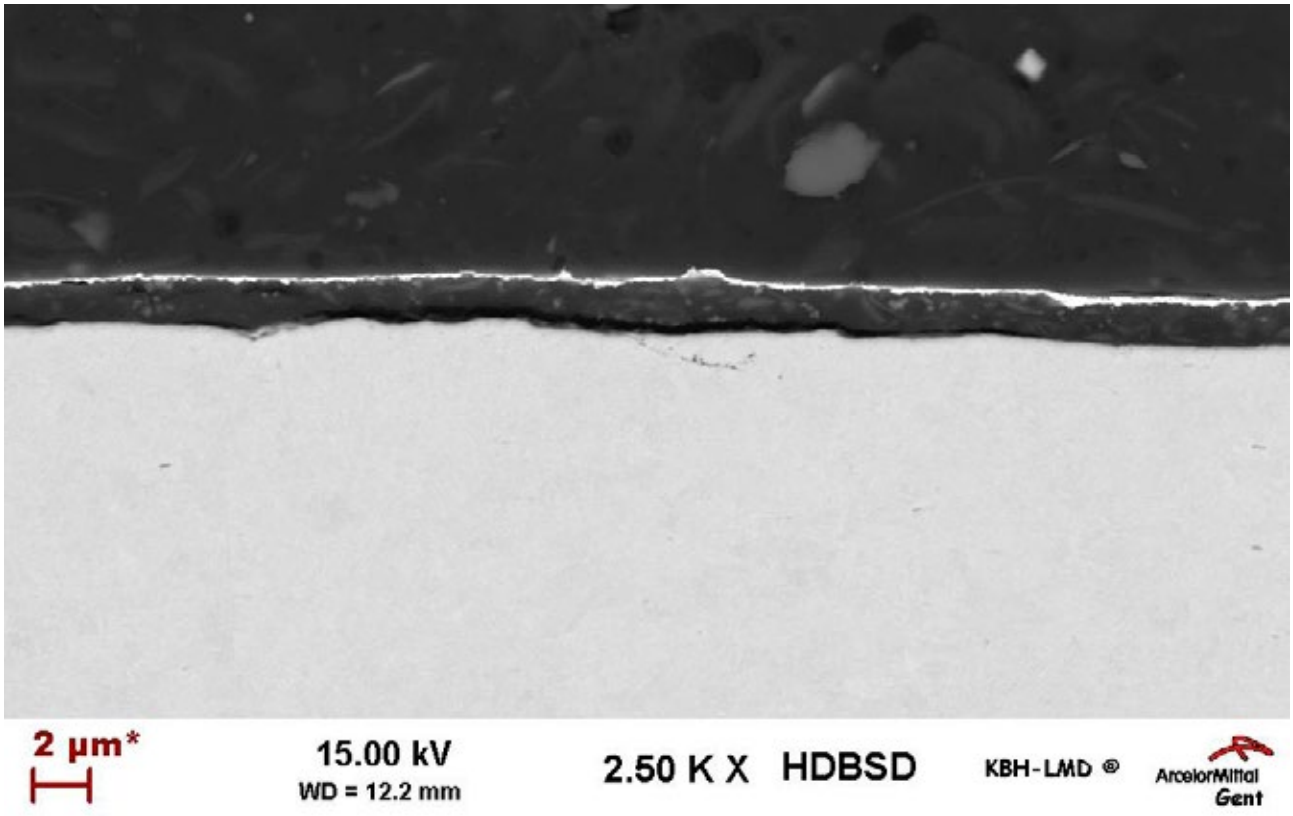
Before embedding the sample, a 10 nm gold coating is applied. This will be used to determine the thickness of the organic coating. After embedding and polishing, the cylindrical sample gets a second gold coating to prevent charging in the SEM.

The LUXOR holder for mounted/embedded samples

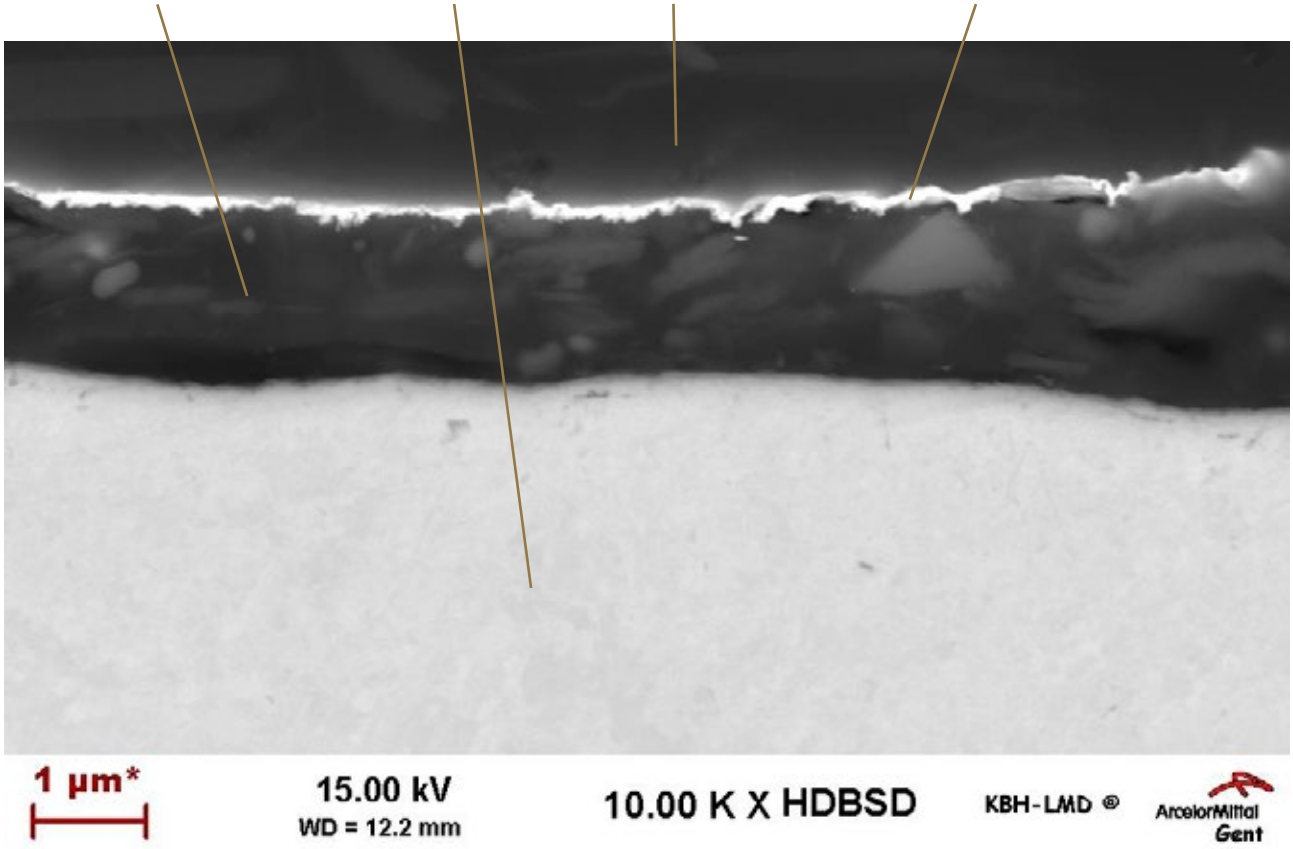


Metal sheet rolls held together with metal strips

BSD images at 2.500x and 10.000x magnification from ArcelorMittal's Zeiss Sigma 500 VP FE-SEM.



Organic coating on metal Metal strip Embedding resin 10 nm gold coating



Other research projects in the lab involve dealing with complaints or concerns from local residents or nearby companies. As such, the lab is sometimes commissioned to investigate the composition of an unknown powder that was found on a roof surface or garden furniture. Or it is asked to find out whether some type of corrosion on a car, metal or plastic surface can possibly be linked to ArcelorMittal. In such cases, a technician goes on site to take a sample with swabs or cloths. These also need to be coated before going into the SEM.

In front of ArcelorMittal's Thermo FEI Explorer automated SEM: "The one that never sleeps."

Digging deep into the secrets of metallography with the Zeiss Sigma 500 VP FE-SEM

"THE LUXOR UPSIDE-DOWN SETUP IS UNIQUE"

LUXOR^{Au} SEM COATER IN THE LAB

Experiences with the LUXOR^{Au} coater after a few weeks of use in the lab are certainly positive. Here are some first impressions:

"As far as the LUXOR^{Au} gold coater is concerned, we can already say that this device represents an important step forward for sample preparation in the lab. The previous device needed replacement due to its age, manual operation, and difficulty in controlling coating thickness.

The LUXOR^{Au} is a compact and fully automated instrument. All we need to do is enter the coating thickness and push start. The layer thickness is also checked very precisely, and we see that, unlike before, the gold coating is practically transparent, a clear indication that it is in the requested 10 nm range.

The unique upside-down setup also ensures that we have less contamination from loose particles in our microscopes The entire coating process from inserting the mounted samples into the special sample holder to the end venting takes about 5 minutes. And because it runs fully automatic, you do not have to stay close to it either."

Would you also like to learn more about how LUXOR SEM coaters can help make sample preparation in your lab easier, faster, more precise and more reproducible? Then contact us at www.luxor-tech.com.

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