Ebatco Nano
A Bimonthly Newsletter

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Nano Brief

To appreciate our loyal customers and inspiring and supportive friends, and to welcome our new and prospective customers, we are planning on an Open House at our new facility in June. In addition to food and drinks, presentations, demos, door prizes, raffle drawings are expected to make the event fun and interesting. Keep an eye on your mailbox for invitation soon!

Ebatco

The Ebatco NAT Lab has just acquired a JSM-6610LV Scanning Electron Microscope (SEM) with a QUANTAX 200 Energy Dispersive Microanalysis System (EDS) to augment our nano-scale surface analysis and characterization capabilities even further. The JSM-6610LV, manufactured by JEOL Ltd., can operate in either a high vacuum mode or a low vacuum mode with magnifications up to 300,000X. In high vacuum mode, the JSM-6610LV can reach a resolution of 3 nm and acceleration voltage of 30 kV for surface topographical and metallographical analysis. In low vacuum mode, the JSM-6610LV offers variable gas pressures up to 270 Pa within the vacuum chamber to allow for and facilitate the analysis of the samples without conductive coating. This capability is essential for analysis of the samples that are not allowed to be altered by conductive coating process for compositional and/or forensic reasons, or the samples that are non-conductive or tend to outgas significantly. The QUANTAX 200 EDS with X Flash 6 detector, manufactured by Bruker Nano GmbH, is equipped with an outstanding sixth-generation silicon drift detector, high resolution and high throughput X-ray spectrometry for chemical and elemental characterization, automatic phase and feature analysis of materials containing atoms from boron to americium.

The JEOL JSM-6610LV SEM with Bruker QUANTAX 200 EDS system.

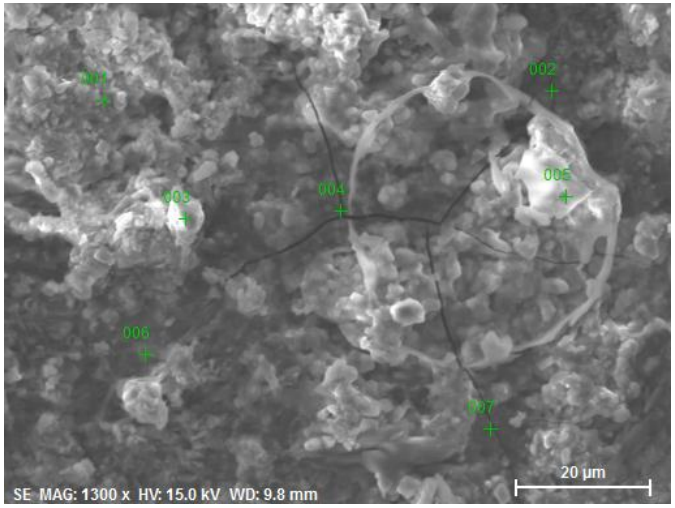
Case Study

The process and nature of corrosion is of utmost importance across a wide array of fields. Knowing the properties of the corroded material is a crucial step in gaining an understanding as to why and how the corrosion occurred. Corrosion can take on various forms and behaviors even within a small area of a given material, so being able to examine a specific point on the sample is greatly useful in the analysis of the corrosion.

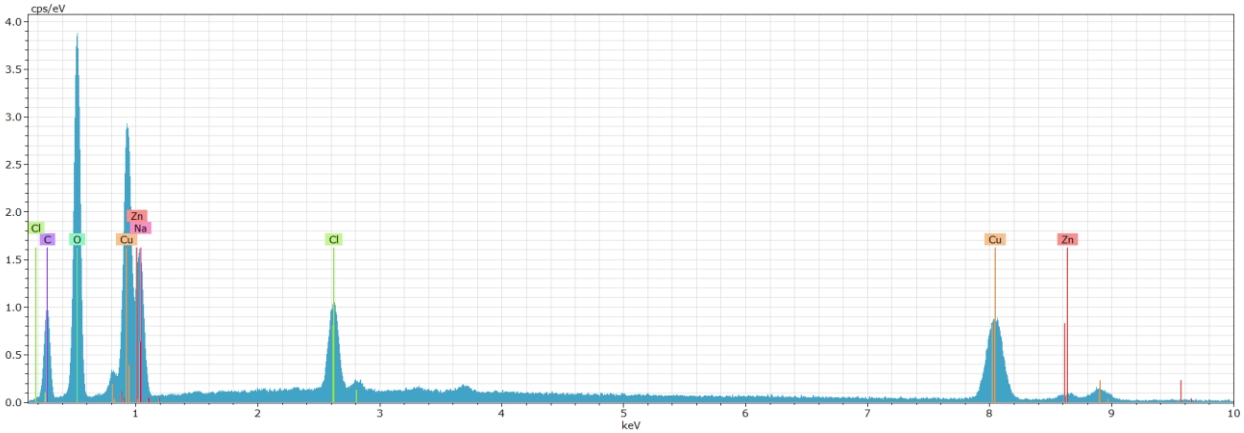
One method for analyzing corrosion is by means of a SEM equipped with EDS. With this system, micrographs can be taken for morphological inspection to understand how the corrosion surface is forming and changing. Pits, cracks, fractures and other microscopically observable characteristics of the corroded materials are useful to visualize what may have happened. In addition to SEM observations, the EDS system can further assist in identifying and quantifying the chemical compositions of the micro areas of interest. Working in tandem, SEM and EDS analyses can reveal a tremendous amount of useful information on corrosion processes and mechanisms, as well as material anti-corrosion properties.

As an example to illustrate the above points, a corroded penny was briefly studied in our SEM/EDS system. A SEM micrographic image was taken on a green colored area and EDS compositional spectra were taken at several points as indicated by the numbers in the first figure below. The second figure shows a typical spectrum of the corroded area. From the SEM image, it is obvious that the

corroded area has characteristics of severe metal corrosion: uneven, porous and powdery microstructure, and cracks on the surface caused by corrosion stresses. The EDS compositional analysis has indicated that three main elements in the majority of locations are copper, oxygen, and carbon. It is suspected that these elements are existing in the forms of copper (I) carbonate or copper (II) carbonate as the results of penny corrosion. Some small amounts of zinc, the alloying material used in pennies produced between 1962 and 1982, such as the 1976 penny we examined, were also detected in some of the locations. In addition, all analyzed locations show some amounts of chlorine. This could be evidence of copper or zinc chlorides present due to corrosion. Furthermore, the presence of sodium suggests some amount of sodium chloride, likely due to sweat deposited on the surface when handling of the penny.



SEM micrographic image of a corroded area on a penny coin, EDS point analysis locations indicated with green color numbers.



A typical EDS spectrum, taken at point 001 shown on the picture above.

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Ebatco, 7154 Shady Oak Road, Eden Prairie, MN 55344
+1 952 746 8086 | info@ebatco.com | www.ebatco.com