

Electrochemistry in the quality control of food and beverage packaging



By Corrado Locati

The shelf life of foods and beverages depends to a great extent on the packaging material. Metals are ideally suited for this purpose, as they can be coated with different passivating food-grade layers. Nevertheless, electrochemical measurements such as impedance spectroscopy (EIS) are required to monitor the integrity of the sealing layers.

Metrohm White Paper

Metal layers in packaging

Different materials for packaging are available in the market. Aluminum is often used to make cans or bound with paper to produce laminated and metallized films. Steel is the main component of tinplate, where it is often coated on both sides with thin layers of tin. Tin-free steel packages can be also found, with a layer of electrolytic chromium or chromium oxide [1].

Corrosion as drawback

In any case, the use of metals is strongly hampered by corrosion, which can occur either in the side exposed to the atmosphere and in the side exposed to the content. Therefore, metals are further coated and/or lacquered [2].

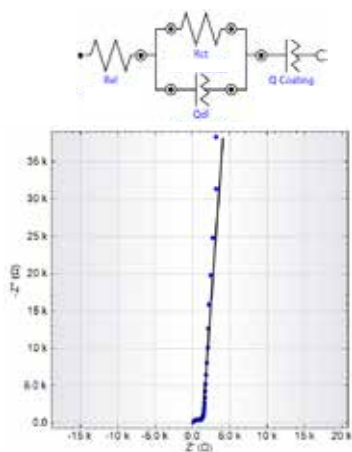
Electrochemistry as indispensable monitoring tool

It is clear the importance of investigating corrosion processes in metal packages [3]. One of the most common ways to study corrosion is to exploit its electrochemical nature. Therefore, Autolab Potentiostats have been extensively employed for electrochemical research in corrosion analysis, also related to food packaging [4]. The AUTOLAB potentiostats in combination with the FRA32M module and the corrosion package allow researchers to perform full electrochemical investigations. Thanks to the NOVA software, it is possible to set

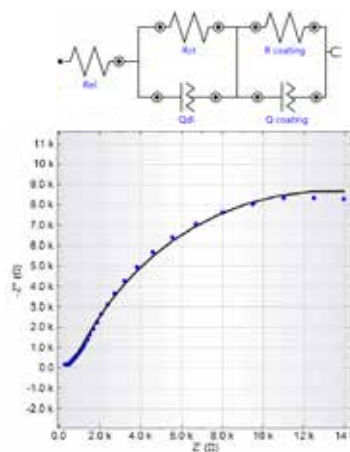
up customer-tailored procedures, such as polarization curves, anodic stripping voltammetry, and impedance spectroscopy. Among the above-mentioned techniques, impedance spectroscopy (available with the FRA32M module) is one of the most used, because it is non-destructive, quick (a measurement is in the minutes range) and it gives complete information on the quality and duration of corrosion interfacial processes.

References

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- [2] K. Marsh, and B. Bugusu, "Food Packaging—Roles, Materials, and Environmental Issues", Journal of Food Science, Vol. 72, Nr. 3, R39–R55, 2007.
- [3] X. Da-hai et al., "Corrosion behavior of tinplate in NaCl solution", Transaction of Nonferrous Metals Society of China, Vol. 22, 717–724, 2007.
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Coating



Coating

The Figure shows different impedance responses between a metal substrate with a good coating (right) and a metal substrate with the coating partially removed (left).

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