

Highlights of Analytical Chemistry in Switzerland

In situ Element-Specific and Time-Resolved Investigation of Micro-Corrosion Processes

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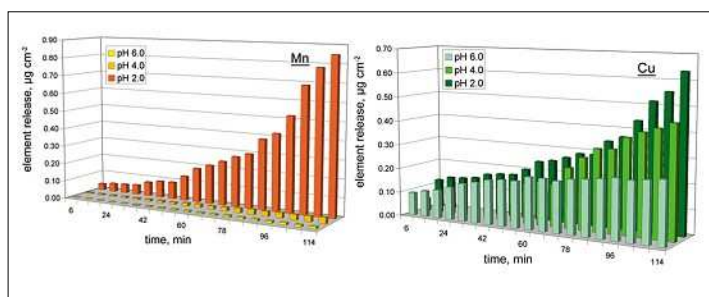
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Detailed information on corrosion processes provides the key to effective prediction and minimization of corrosion damages. The initiation stage of material decomposition plays a special role, since the corrosion often starts at the weakest locations such as surface defects, grain boundaries, segregations or inclusions. How-



Corrosion is an economic issue since it destroys material goods



Time-resolved dissolution behavior of Mn and Cu in AA 6111 using 0.1 M NaCl corrosive media at different pHs

ever, surface analysis or electrochemical methods commonly used in corrosion research (*e.g.* electrochemical methods, SEM-EDX, *etc.*) cannot present local element-specific and online *in situ* information at the same time.

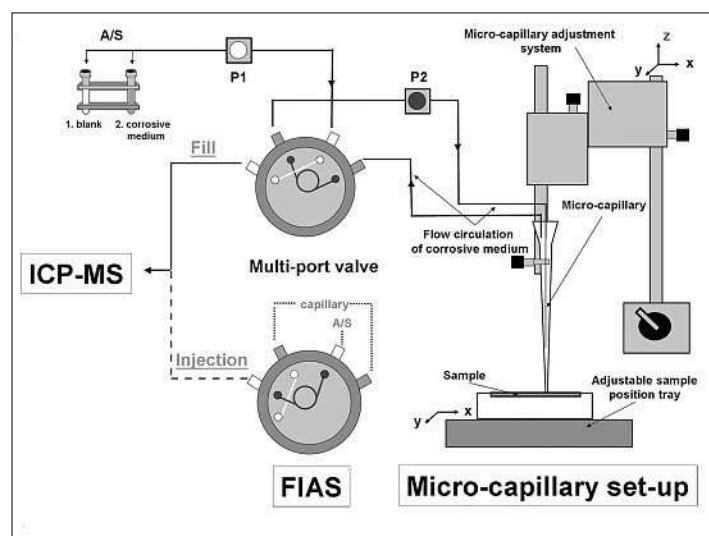
As a solution a technique for localized element-specific investigations of corrosion processes has been developed. The technique is based on an adjustable online microflow-capillary set-up especially designed for local *in situ* experiments at trace and ultratrace concentration levels. The capillary is online connected *via* flow injection (FI) analysis system to an inductively coupled plasma mass spectrometry ICP-MS. FI allows a transient sample introduction, whereas ICP-MS is designed for highly sensitive multi-element quantification.

The efficiency of the developed technique could be proved by corrosion susceptibility analysis of a commercial aluminum alloy. The influence of various factors such as exposure time or pH value of corrosive media on the element-specific dissolution rates was studied in alloy AA 6111. This information is especially valuable for alloying elements present in the alloy in sub-percent quantities, which could also be detected in very low concentrations in the solution as *e.g.* Cu and Mn. The element-specific investigation of corrosion behavior of AA 6111 revealed a relatively high release of the secondary alloying element Cu in the studied pH range. **New insights into the behavior of copper during the corrosion process, not fully understood so far, can be obtained with the newly developed *in situ* experiments.**

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References

- N. Homazava, A. Ulrich, M. Trottmann, U. Krähenbühl, *J. Anal. Atom. Spectrom.* **2007**, 9, 1122.
- N. Homazava, A. Ulrich, U. Krähenbühl, *Spectrochim. Acta, Part B*, submitted.



Principle of the novel microcapillary FI-ICP-MS set-up

Can you show us your analytical highlight?

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