E-beam induced writing of corrosion protection

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A well-known case of electron beam-induced patterning is the formation of carbon rich contamination layers in scanning electron microscopes (SEMs). The e-beam activates reactions of the residual hydrocarbons (molecules from the pump oil) in diffusion pumped systems to create a highly cross-linked hydrocarbon deposit.

In previous work we have shown how to use these electrically insulating carbon deposits as masks for electrochemical deposition and for the production of nanostructured surfaces (1-3).

The present work explores possibilities to use such carbon masks (C masks) produced by contamination writing in a SEM to suppress corrosion process on iron (99.5%) surface.

Figure 1 shows an SEM image for a C-patterned iron sample after chemical etching for 5 min in 3% HNO₃. The surface is corroded except for sites that correspond to the location of the carbon layers. In the carbon free region of the sample, dissolution leads to etching of the iron surface resolving the grain structure. Similar results were obtained for samples polarized in the active dissolution region in borate buffer, pH 8.4.

The results clearly demonstrate that electron beam-induced C-masking of an iron substrate can be used for selective corrosion protection. The C-deposits have a sufficiently high stability to act as a protective layer and thus to locally hinder iron dissolution.

Factors affecting the stability and use of this local masking effect will be discussed.

References: