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Kinetics of cathodic reduction of oxygen on Ni-Cr-Mo-W alloy.

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Kinetics of cathodic reduction...

Composition of Alloy 22.

Element	Amount, wt. %
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Ni	Balance
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Cr	21.000
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Mo	13.300
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W	2.900
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Fe	3.900
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Co	0.727
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Mn	0.231
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Si	0.026
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V	0.012
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P	0.011
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S	0.004
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C	0.003
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Kinetics of cathodic reduction...

Main directions of the research.

Kinetics of cathodic reduction...

Experimental conditions.

- **Solution:**
 - 5 mol L⁻¹ NaCl
 - Temperature: 30°C – 90°C
 - Saturated with O₂ or deaerated by Ar
- **Conventional three-electrode electrochemical cell**
 - Working electrode – Alloy 22 sample with geometric surface areas 0.785 cm²
 - Ag/AgCl reference electrode; E=0.199 V vs. NHE
 - Pt counter electrode
- **RDE used to minimize the influence of diffusion processes while measuring cyclic voltammograms. The angular velocity of the electrode was 23.5 Hz**

Kinetics of cathodic reduction...

XPS experimental conditions.

O_2 free solution / 30°C

Kinetics of cathodic reduction...

Surface Analysis. XPS Survey Spectra.

Kinetics of cathodic reduction... Surface Analysis. Ni High Resolution XPS.

Kinetics of cathodic reduction...

Surface Analysis. Cr High Resolution XPS.

Kinetics of cathodic reduction... Surface Analysis. Mo High Resolution XPS.

Kinetics of cathodic reduction... Surface Analysis. W High Resolution XPS.

Kinetics of cathodic reduction...

Surface Analysis. High Resolution XPS Results.

Kinetics of cathodic reduction...

EIS experimental conditions.

Kinetics of cathodic reduction... Surface Analysis Model.

$$R_P = R_{CT} + R_F + R_S \text{ at } \omega = 0$$

Kinetics of cathodic reduction...

EIS results.

Defect annealing

Kinetics of cathodic reduction...

EIS. Temperature dependence.

Kinetics of cathodic reduction...

Oxygen reduction experimental conditions.

O_2 saturated solution.

Kinetics of cathodic reduction...

Oxygen reduction.

Kinetics of cathodic reduction... Oxygen reduction.

Kinetics of cathodic reduction...

Oxygen reduction.

Kinetics of cathodic reduction...

Summary.

- Electrical and compositional properties of the protective film determined by EIS and XPS
- Film polarization resistance depends on pre-oxidation potential with a maximum in the potential interval -0.3 to 0.3 V
- Cyclic voltammograms demonstrate that Alloy 22 can support oxygen reduction reaction under some conditions
- XPS data show that the composition, and perhaps also the thickness, of the oxide film on Alloy 22 have a significant effect on the alloys ability to suppress oxygen reduction
- The role of Mo in determining the corrosion resistance of Ni-Cr-Mo-W alloys should be elucidated closely taking into account the role of Mo as a supercapacitor and catalyst for O₂ electroreduction

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