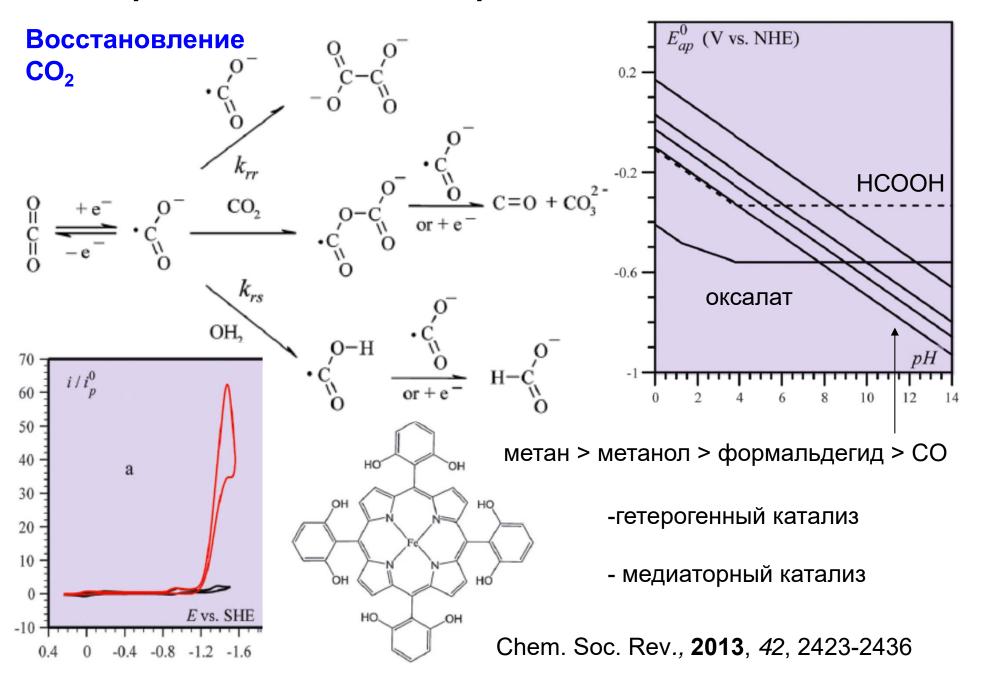
13. Еще некоторые практически важные и необычные электродные процессы

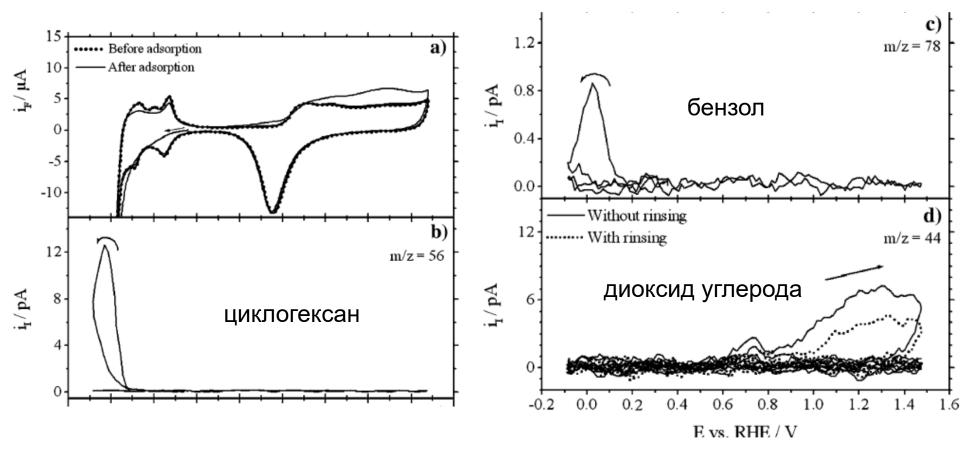
- электрокатализ НЕ для сенсоров и НЕ для топливных элементов
- коррозионная защита
- электрохимия «в экстремальных условиях»
- плазменно-электрохимические процессы
- комбинаторная электрохимия



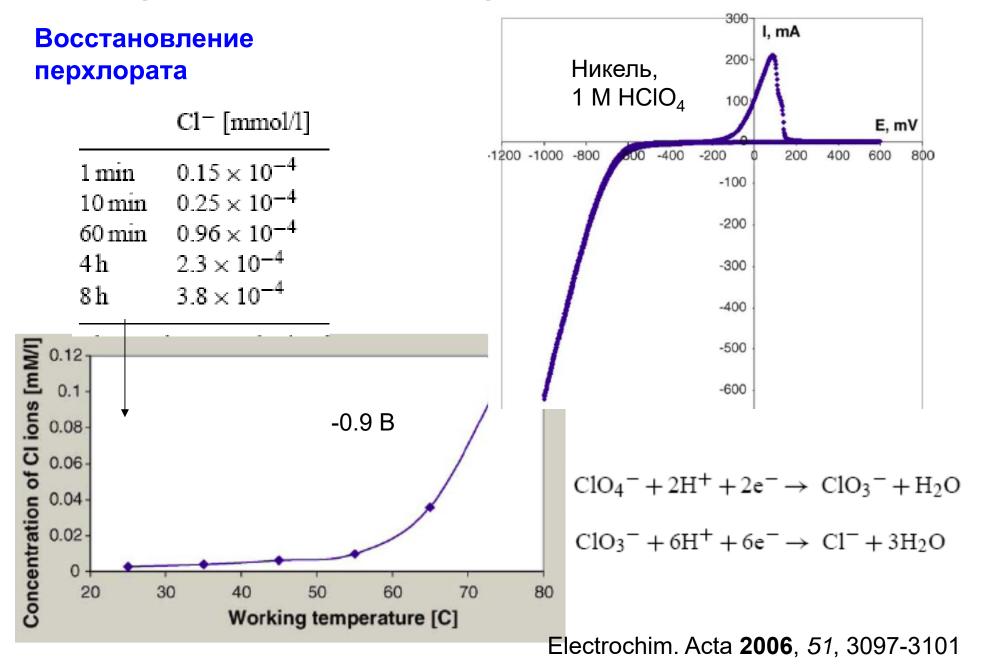
Восстановление гидрохинона

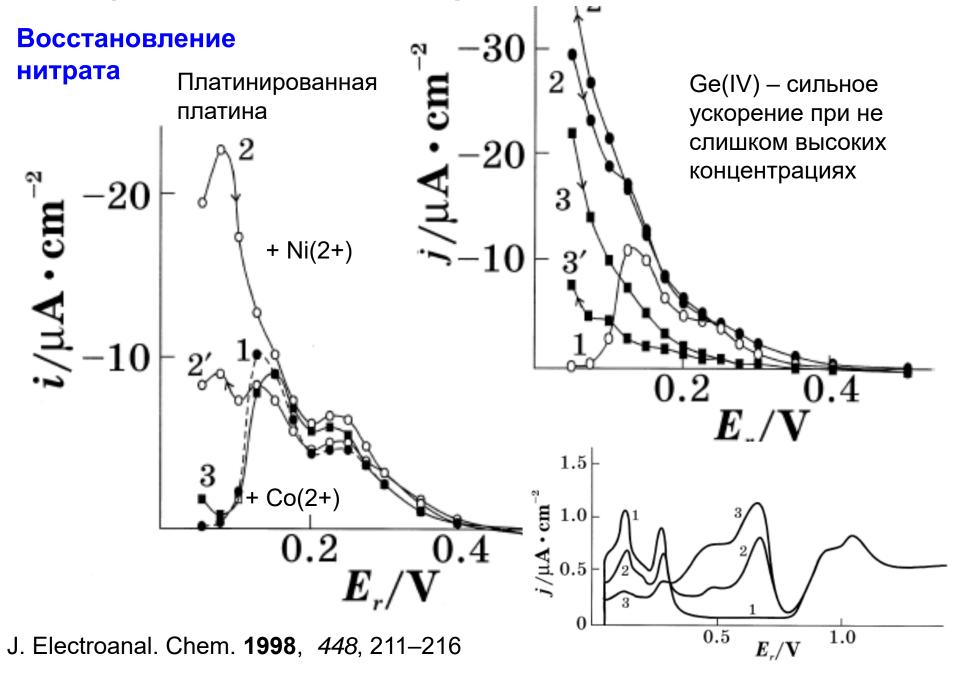
$$H_2Q_{(ads)} \xrightarrow{Hydrogenation} Cyclohexane_{(aq)}$$

+Benzene_(aq) + Non-volatile products



J. Appl. Electrochem. **2006**, *36*, 1253–1260





Коррозионная защита

$$M^{n+} + nCl^{-} \rightarrow [M(Cl)_n]_{ads}$$

$$[M(CI)_n]_{ads} + Inhibitor_{(sol)} \rightarrow [M^{n+} - inhibitor] + nCI_{(sol)}$$

Обзоры: J. Molec. Liquids 248 (2017) 927-942; RSC Adv. 6 (2016) 62833-57

$$HN$$
 N
 NH_2
 $N-N$
 NH_2
 NH_2
 N
 N

AI, его сплавы

$$HS \xrightarrow{O} OH$$

Си, ее сплавы

(PTS)

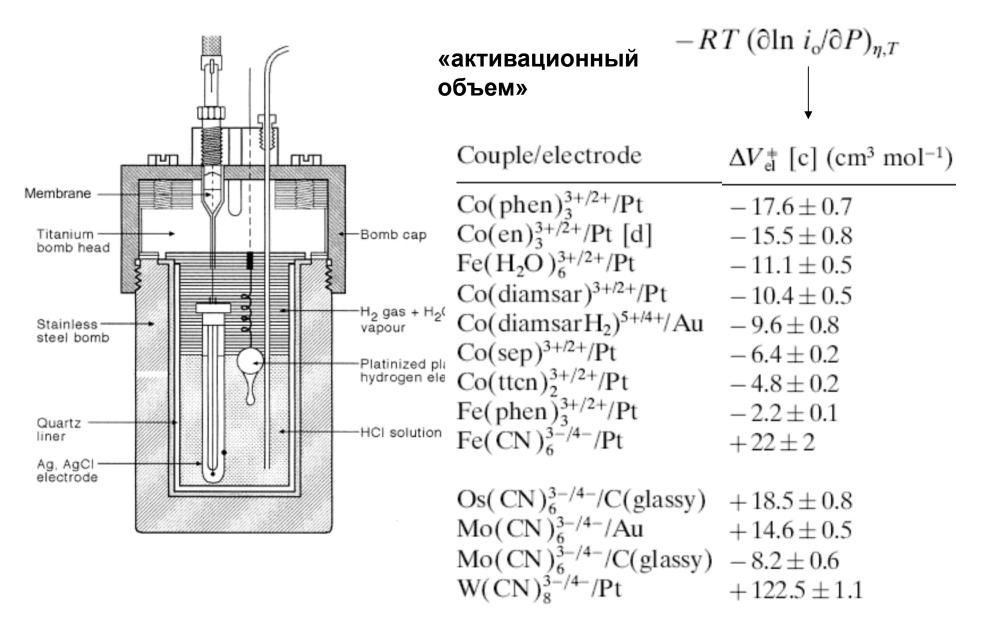
Стандарты коррозионных тестов

https://www.astm.org/Standards/corrosion-and-wear-standards.html

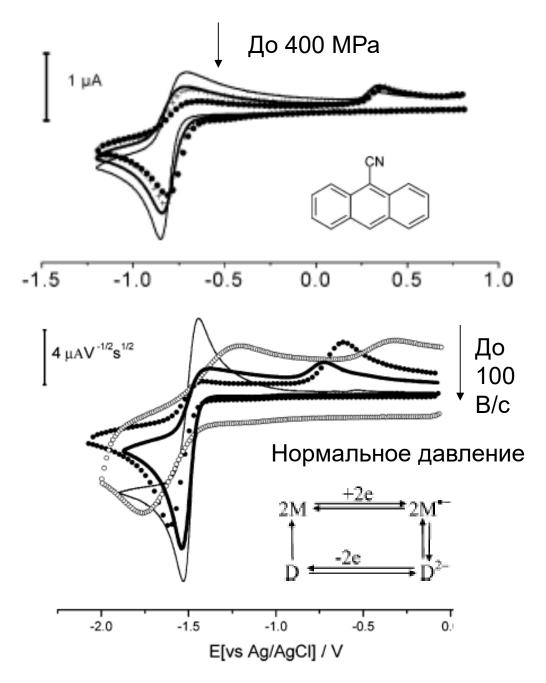
Electrochemical Measurements in Corrosion Testing

Designation	Title
<u>G3 - 14</u>	Standard Practice for Conventions Applicable to Electrochemical Measurements in Corrosion Testing
<u>G5 - 14</u>	Standard Reference Test Method for Making Potentiodynamic Anodic Polarization Measurements
<u>G59 -</u> <u>97(2014)</u>	Standard Test Method for Conducting Potentiodynamic Polarization Resistance Measurements
<u>G61 -</u> <u>86(2014)</u>	Standard Test Method for Conducting Cyclic Potentiodynamic Polarization Measurements for Localized Corrosion Susceptibility of Iron-, Nickel-, or Cobalt-Based Alloys
<u>G69 - 12</u>	Standard Test Method for Measurement of Corrosion Potentials of Aluminum Alloys
<u>G71 -</u> <u>81(2014)</u>	Standard Guide for Conducting and Evaluating Galvanic Corrosion Tests in Electrolytes
<u>G82 -</u> <u>98(2014)</u>	Standard Guide for Development and Use of a Galvanic Series for Predicting Galvanic Corrosion Performance
<u>G96 -</u> <u>90(2013)</u>	Standard Guide for Online Monitoring of Corrosion in Plant Equipment (Electrical and Electrochemical Methods)
<u>G100 -</u> <u>89(2015)</u>	Standard Test Method for Conducting Cyclic Galvanostaircase Polarization
G102 -	Standard Practice for Calculation of Corrosion Rates and Related Information from Electrochomical Measurements

Электрохимия при высоких давлениях



Обзор: Elecatoanalysis 2004, 16, 789-810



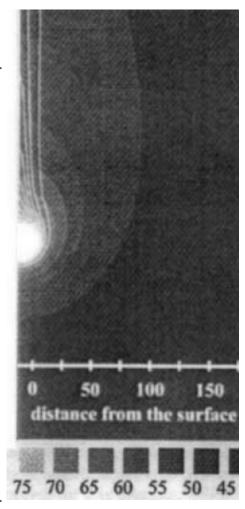
J. Phys. Chem. A **2004**, *108*, 230-235



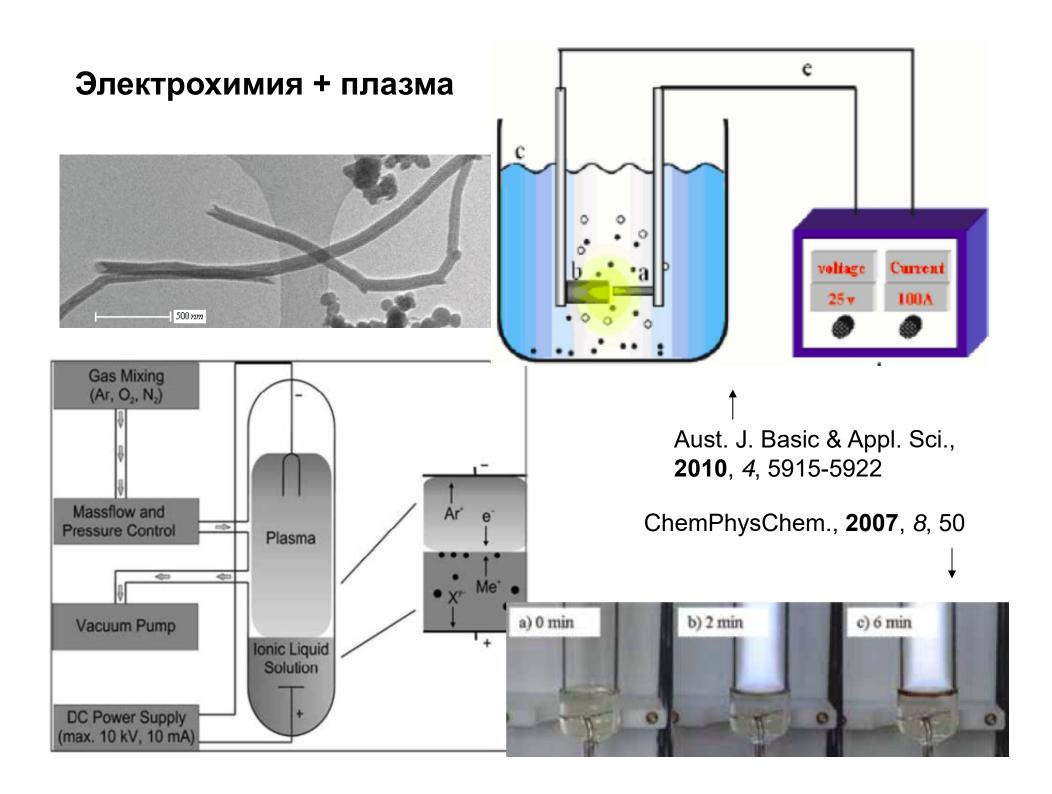
Электрохимия при высоких температурах

Проблемы: температурный скачок потенциала, температура электрода сравнения

Redox couple and solvent	Heating Method	$E_{\rm A}$ (kJmol ⁻¹)
Fe(CN) ₆ ⁴⁻ /H ₂ O	Radio frequency	13.0
$Fe(CN)_6^{4-}/H_2O$	Heat gun	13.8
$Ru(NH_3)_6^{3+}/H_2O$	Radio frequency	13.5
$Ru(NH_3)_6^{3+}/H_2O$	Heat gun	13.8
TMPD/H ₂ O	Radio frequency	18.0
TMPD/H ₂ O	Heat gun	16.1
$TMPD/H_20$	Variable-temperature cell	19.0
TMPD/Acetonitrile	Radio frequency	9.0
TMPD/Acetonitrile	Heat gun	10.0
TMPD/Acetonitrile	Variable-temperature cell	10.0
Fe(Cp) ₂ /Acetonitrile	Radio frequency	7.0
Fe(Cp) ₂ Acetonitrile	Heat gun	6.9
Fe(Cp) ₂ /Acetonitrile	Variable-temperature cell	6.9
Fe(Cp) ₂ /Acetonitrile	AC Heating	12.1



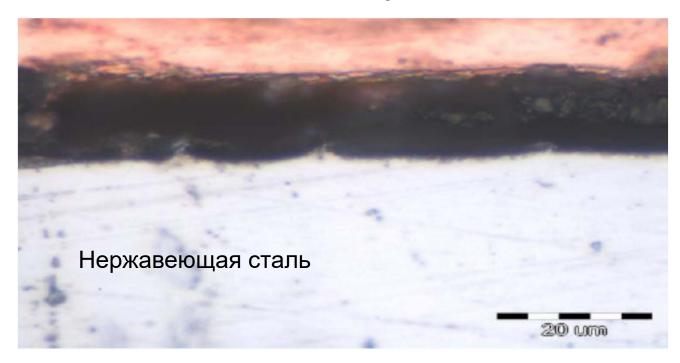
Обзор: Elecatoanalysis 2004, 16, 421-433



Плазменно-электрохимическая обработка поверхности

Electrolyte	Voltage range[V]	Duration range [s]
Water, Glycerin, and NH ₄ Cl	80-120	50-120
Water, Glycerin, and NH ₄ Cl, Borax	80-120	50-120

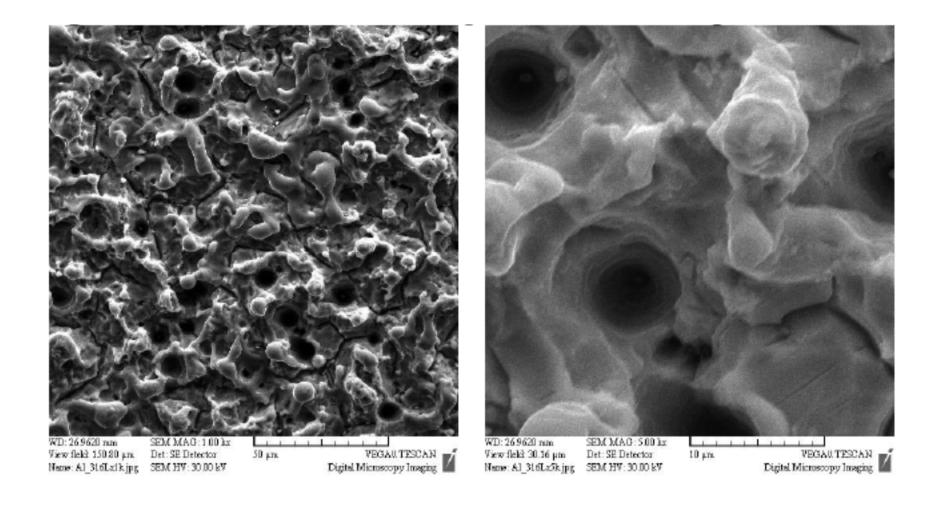
Анодный процесс



Катодный процесс

Мочевина + ионная жидкость на основе AlCl₃

$U_{\text{treatment}} = 125 \text{ V}$	U _{stabilization} =170 V	U _{heating} =210 V
$t_{treatment} = 35 \text{ s};$	$t_{\text{stabilization}} = 80 \text{ s}$	$t_{\text{heating}} = 90 \text{ s.}$



initial state

polished sample



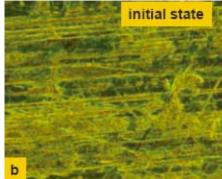


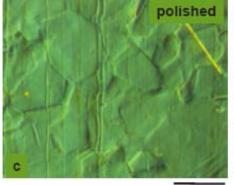
Плазменноэлектрохимическая полировка

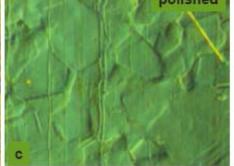
Хромникелевая сталь



50 µm







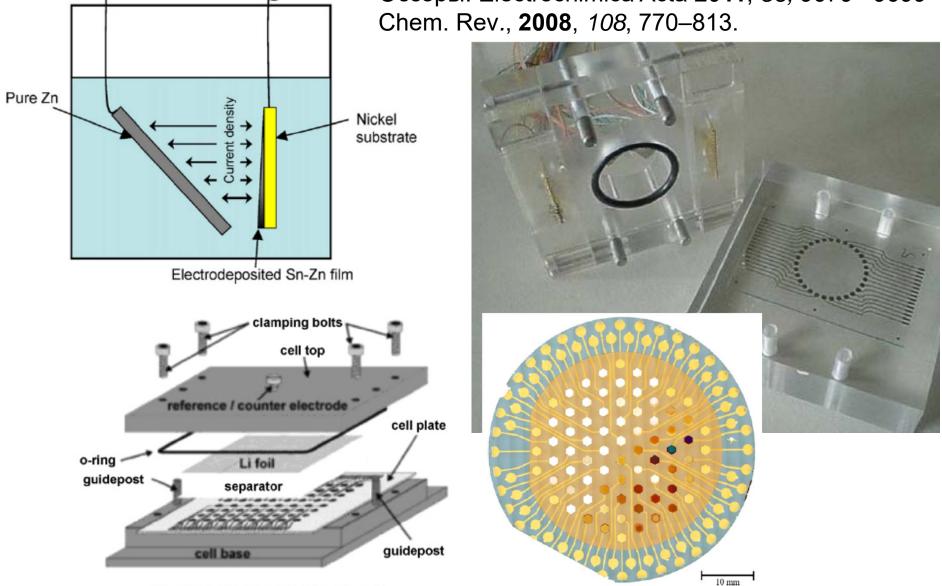
15 c 0 c 30 c

complexing agent	suitable for	<i>p</i> H-range
tartaric acid (TA)	Cu, Zn	7–10, 11–12
citric acid (CA)	Cu, Zn	5-12
ethylenediamine tetraacetate (EDTA)	Cu, Ni, Co, Zn, Al, Fe	0.5 < <i>p</i> H
Nitrilo triacetate (NTA)	Ca, Cu, Ni, Zn, Fe	2-7, 10-12
Diethylenetriamine pentaacetate (DTPA)	Me ⁿ⁺ with large radius	0.5 < pH

50 µm

«Комбинаторная» электрохимия

Обзоры: Electrochimica Acta **2011**, *56*, 9679– 9699 Chem. Rev., **2008**, *108*, 770–813.



64 channel combinationial cell

Working electrode

Counter electrode

Arrays (наборные электроды)