Peptides as receptors for metal ions in potentiometric chemical sensors

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Importance of monitoring copper concentration

Copper deficiency
- anemia, neutropenia, bone abnormalities

Elevated copper concentrations
- damage of the liver, brain and other organs, copper poisoning

Neurodegenerative diseases
- Copper plays an important role in the pathogenesis of Alzheimer’s and Parkinson’s diseases

Monitoring of copper concentration is necessary
Working principle of ISFET

**State of the art**
- flame and electrothermal atomic absorption spectrophotometry,
  atomic emission spectrometry with inductively coupled plasma
  - remain expensive
  - sample pre-treatment
  - large sample quantities
  - time-consuming

**ISFET**
- compact
- convenient in use
- low production cost
- perspectives
- small sample volume
- differential measurements

**ion-sensitive field-effect transistor**

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\Delta \Psi = -\Delta V_{th}
\]

\[
\Delta \Psi = - \frac{\Delta I_{sd}}{g_m}
\]

ISFETs convert chemical reaction into an electric signal
GGH peptide as a receptor for copper ions and response of the GGH ligand to Cu(NO₃)₂ in the low concentration range

- Peptides are present in the human body and participate in important processes
- Selective to certain metal ions

**GGH**
(Glycyl-Glycyl-Histidine)

Lipoic acid

Lpa-GGH monolayer on a gold surface and the complexation of Cu²⁺ ions.

**Complex chelation mechanism**

pH of the electrolyte solution significantly affects the device’s response

O. Synhaivska et al., Sensors 2019
Response of the GGH ligand to Cu(NO$_3$)$_2$ in the high concentration range

Non-specific adsorption is a dominating factor at high concentrations
Conclusions & Outlook

- Peptides are more sensitive to the environmental conditions compared to more simple molecules, such as crown ethers.
- Non-specific adsorption dominates the devices response in the high concentration range.
- We are exploring more complex systems for detection of multiple ions.

Neuropeptide Oxytocin