SUPPORTING INFORMATION

Electrochemical and Homogeneous Electron Transfers to the Alzheimer Amyloid-β Copper Complex Follow a Preorganization Mechanism

Véronique Balland, Christelle Hureau and Jean-Michel Savéant

Contribution from the Laboratoire d'Electrochimie Moléculaire, Unité Mixte de Recherche Université - CNRS No 7591, Université Paris - Diderot, Bâtiment Lavoisier, 15 rue Jean de Baïf, 75205 Paris Cedex 13, France and the Laboratoire de Chimie de Coordination, Unité Propre de Recherche CNRS No 8241, 205 route de Narbonne, 31077 Toulouse Cedex, France

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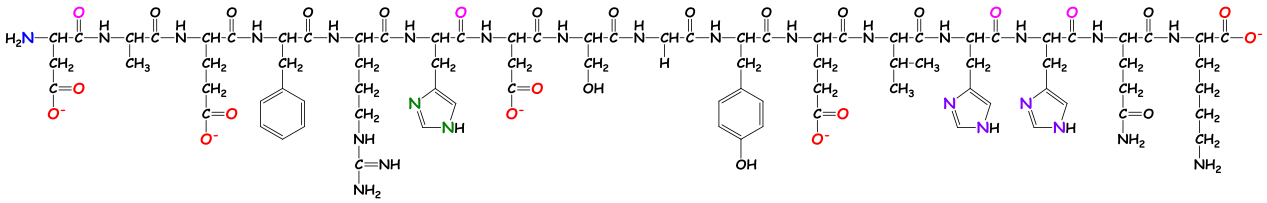
1. Chemicals

1.1 Origin and Structure of the Aβ16 Peptide

Aβ16 peptide (sequence DAEFRHDSGYEVHHQK) was synthesized by GeneCust (Dudelange, Luxembourg). Stock solution of peptide was prepared by dissolving the powder in milli-Q water (resulting pH ~ 2). Peptide concentration was determined by UV-visible absorption of Tyr10 considered as free tyrosine ($\varepsilon_{276}-\varepsilon_{296}$ = 1410 $M^{-1}cm^{-1}$) on a SPECORD S600 spectrometer from Analytic Jena. pH was adjusted to 6.7 by addition of concentrated NaOH solution.

Reminder of amino-acids (in color) involved in copper coordination sphere



1.2 Other Chemicals

All chemicals were purchased from Sigma Aldrich. Buffer solution was 0.025 M Pipes and 0.2 M KCl at pH 6.70. Cu^{II} was added from 50 mM $CuSO_4$ stock solution. $[Os(bpy)_2pyCl](PF_6)_2$ and $[Os(dmbpy)_2Cl_2](PF_6)$ were synthesized according to the literature (1S, 2S), and stock solutions were prepared in DMF.

2. Cyclic voltammetry

Cyclic voltammetry was performed in a standard three-electrode water-jacketed cell by using an Autolab potentiostat (PGSTAT 12, Autolab) interfaced to a PC computed and piloted with GPES software (version 4.7). A saturated calomel electrode, isolated from the solution by a glass frit, and a platinum wire were used as reference and counter electrodes, respectively. Working electrode was a glassy carbon electrode (3 mm diameter) polished by a 3 and 1 mm alumina slurry on a cloth polishing pad and washed with water and ethanol under sonication. CVs were systematically recorded under argon pressure at 20°C.

3. Testing the Reproducibility of the Cyclic Voltammetric Responses of the Cu(Aβ) Complex

Figure 1S summarizes the test of reproducibility of the cyclic voltammetric responses of the Cu(Aβ) complex over three different runs and three scan rates. Reproducibility is excellent at 0.02 and 0.05 V/s and a little less at 0.1 V/s.

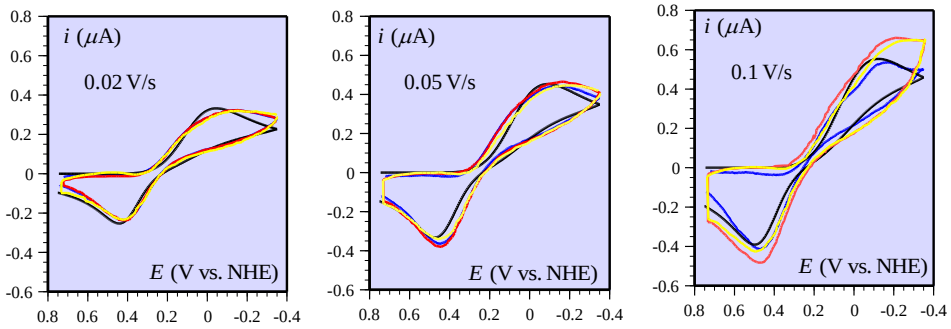


Fig 1S. Cyclic voltammetric responses (corrected from the background current), at a glassy carbon electrode, of a 0.2 mM solution of Cu^{II} in a pipes buffer of *pH* = 6.7 in the presence of 0.2 M KCl after addition of 1mM Aβ16 peptide, as a function of the scan rate (number in each diagram). Test of reproducibility. Blue, red, yellow curves: successive runs. Black curve: simulation (see main text)

4. Cyclic Voltammetry of Free Copper Ions as a Function of Temperature. Arrhenius Plot.

Figure 2Sa show the variation of the peak potentials with scan rate for three temperatures and the simulation lines allowing the determination of the standard rate constant, k_S, at each of these temperatures. The Butler-Volmer law with a 0. 5 transfer coefficient:

$$\frac{i}{FS} = k_S \exp\left[-\frac{F}{2RT}\left(E - E^0\right)\right]\left\{\left[\mathrm{Cu^{II}}\right] - \left[\mathrm{Cu^{I}}\right]\exp\left[\frac{F}{RT}\left(E - E^0\right)\right]\right\}$$

(where i is the current flowing through the electrode, counting the cathodic current as positive, S, the electrode surface area, E, the electrode potential and E^0 the standard potential of the $\mathrm{Cu^{II}/Cu^{I}}$ couple. $\left[\mathrm{Cu^{II}}\right]$ and $\left[\mathrm{Cu^{I}}\right]$ are the concentrations *at the electrode surface*, k_S, the standard rate constant (the common value of the reduction and oxidation rate constants at zero driving) may be applied with a good approximation transfer coefficient rate law

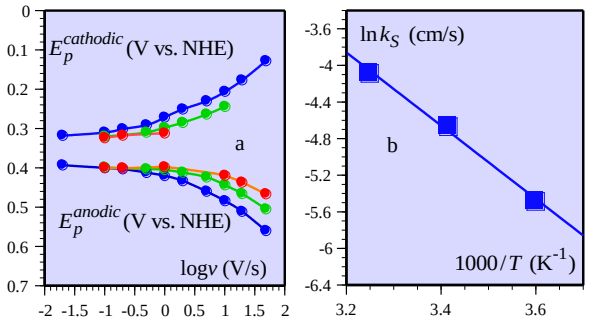


Fig 2S. Cyclic voltammetric responses (corrected from the background current), at a glassy carbon electrode, of a 0.2 mM solution of $\mathrm{Cu^{II}}$ in a pipes buffer of pH = 6.7 in the presence of 0.2 M KCl. a: peak potential variation with the scan rate at 5 (blue dots), 20 (green dots), 35°C (red dots). Full lines: simulation , according to a Butler-Volmer law of the peak potentials for ks = 0. 0042, 0.0095, 0.17 cm/s. Transfer coefficient: 0.5, diffusion coefficient D = 5×10^{-6} cm/s. b: Ensuing Arrhenius plot.

Figure 2Sb shows the ensuing Arrhenius plot, from the reorganization energy, λ, and the pre-exponential factor, Z, could be derived (see main text) , from the slope and the intercept, respectively(3S):

$$\ln k_S \simeq \ln Z - \frac{\lambda}{4RT}$$

References

1S. Takeuchi KJ, Thompson MS, Pipes DW, Meyer TJ (1984) Redox and spectral properties of monooxo polypyridyl complexes of ruthenium and osmium in aqueous media. Inorg. Chem. 23:1845-1851.
2S. Kober EM, Caspar JV, Sullivan BP, Meyer TJ (1988) Synthetic routes to new polypyridyl complexes of osmium(II). Inorg. Chem. 27:4587-4598.
3S. Savéant J-M (2006) Elements of Molecular and Biomolecular Electrochemistry. Chap. 1., (Wiley-Interscience, New-York).