

# Structural Insight into Redox Dynamics of Copper Bound N-Truncated Amyloid- $\beta$ Peptides from *in Situ* X-ray Absorption Spectroscopy

Victor A. Streltsov,<sup>\*,†,‡</sup> Ruwini S. K. Ekanayake,<sup>‡</sup> Simon C. Drew,<sup>||</sup> Christopher T. Chantler,<sup>‡</sup> and Stephen P. Best<sup>§</sup>

<sup>†</sup> Florey Department of Neuroscience and Mental Health, The University of Melbourne, Melbourne, Australia

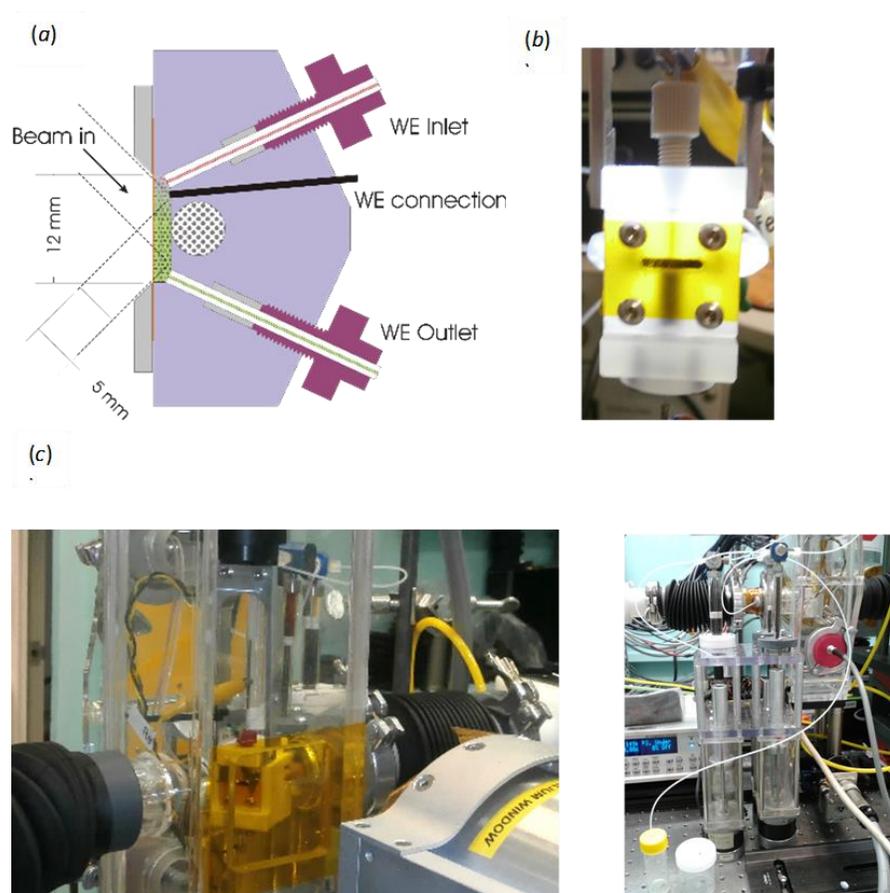
<sup>‡</sup> School of Physics, The University of Melbourne, Melbourne, Australia

<sup>§</sup> School of Chemistry, The University of Melbourne, Melbourne, Australia

<sup>||</sup> Department of Medicine (Royal Melbourne Hospital), The University of Melbourne, Melbourne, Australia

## SUPPORTING INFORMATION

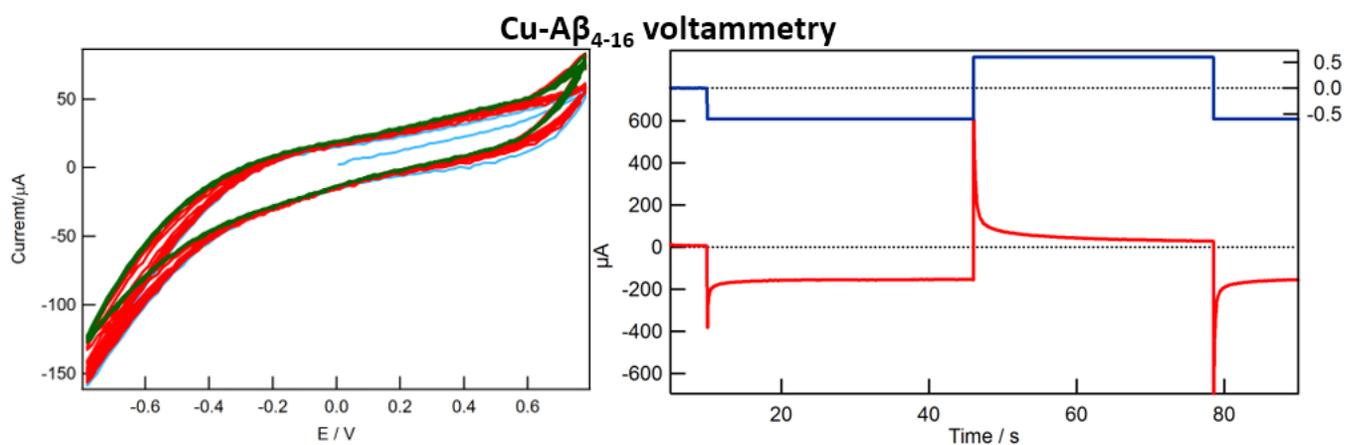
### 2. EXPERIMENTAL SECTION



**FIGURE S1.** XAS-EC cell (a) schematic, section in the plane of the middle of the working electrode (WE); (b) prototype with reference, RE (top) and counter, CE (bottom) visible through the backlit KellF block; (c) cell in the room temperature sample chamber of the XAS beamline. The X-rays pass from left to right with the fluorescence detector in the bottom right. Solutions are introduced using syringe pumps (centre background) with narrow-bore 1/16" Teflon tubing.

### 3. RESULTS SECTION

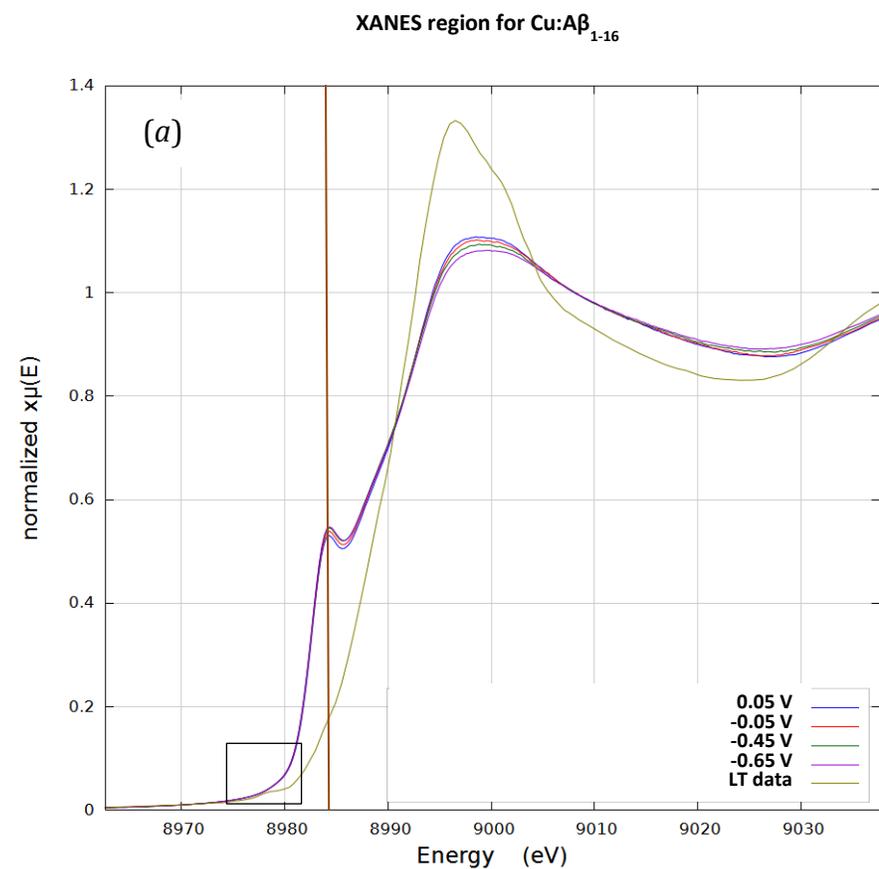
#### XAS-EC



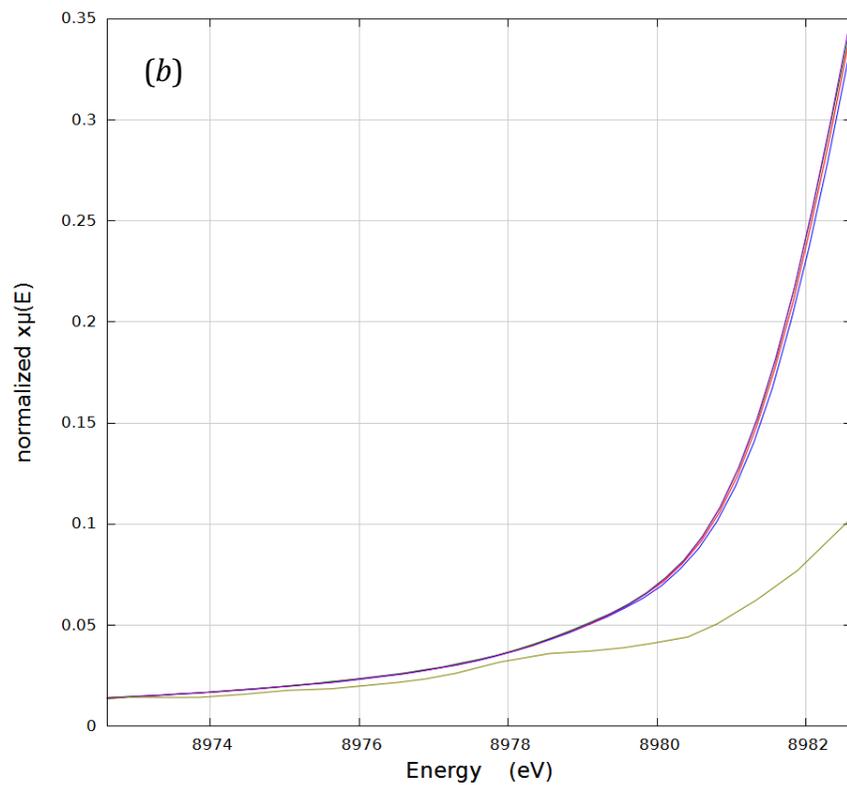
**FIGURE S2.** Cu:A $\beta_{4-16}$  voltammetry: (left) cyclic voltammetry recorded during introduction of solution, (right) step potentials applied under pulse-flow conditions.

#### NEAR EDGE XAS-EC SPECTRA (XANES-EC) AT VARIOUS REDOX POTENTIALS VS. NHE

Cu:A $\beta_{1-16}$



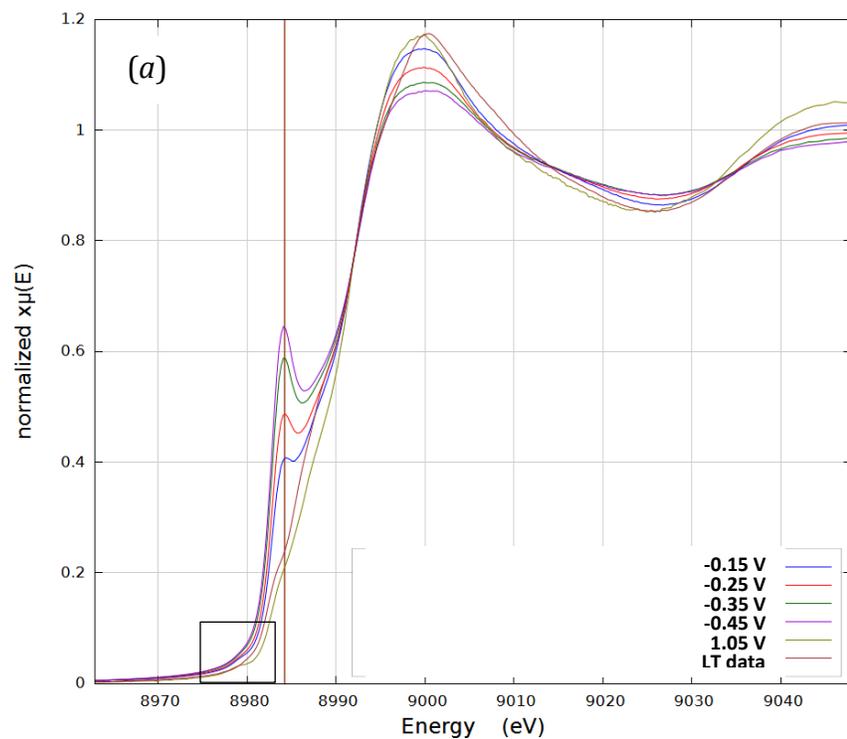
XANES region for Cu:A $\beta_{1-16}$

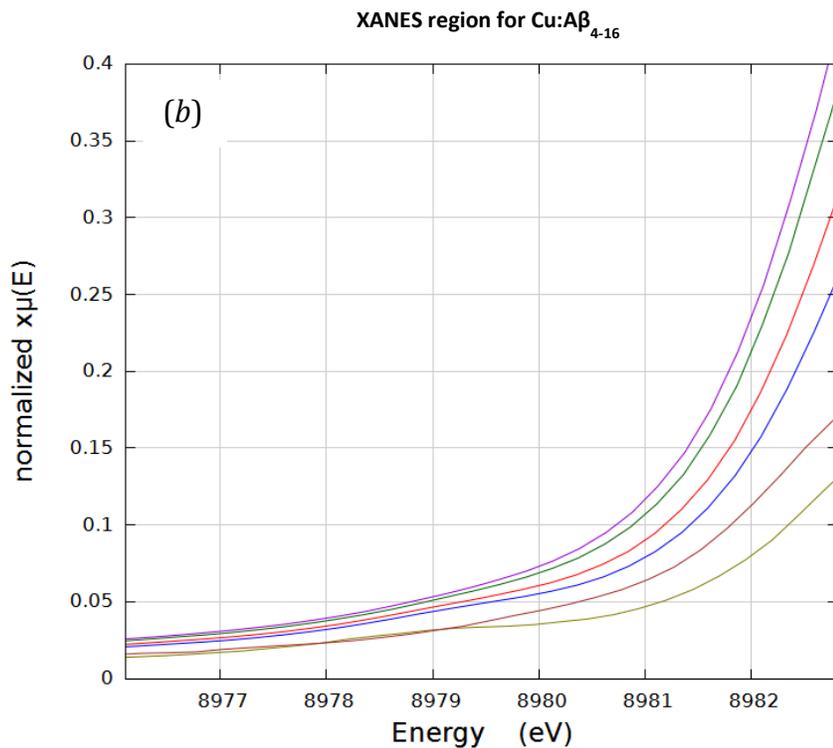


**Figure S3.** (a) XANES-EC region for Cu:A $\beta_{1-16}$  measured at room T and different reducing potentials (0.05, -0.05, -0.45 and -0.65 V vs. NHE). For comparison the low temperature (LT) data is also shown. Position of the characteristic peak of Cu<sup>I</sup> at 8984 eV is indicated with the vertical line. (b) Enlarged section of the plot (a) showing the slight peak at 8978eV for Cu<sup>II</sup>:A $\beta_{1-16}$  at LT.

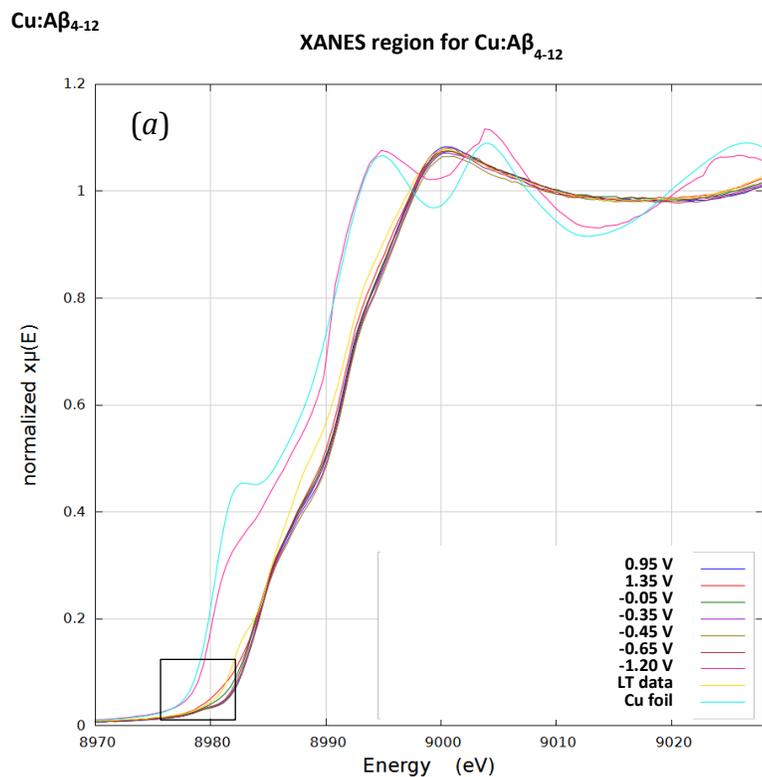
Cu:A $\beta_{4-16}$

XANES region for Cu:A $\beta_{4-16}$

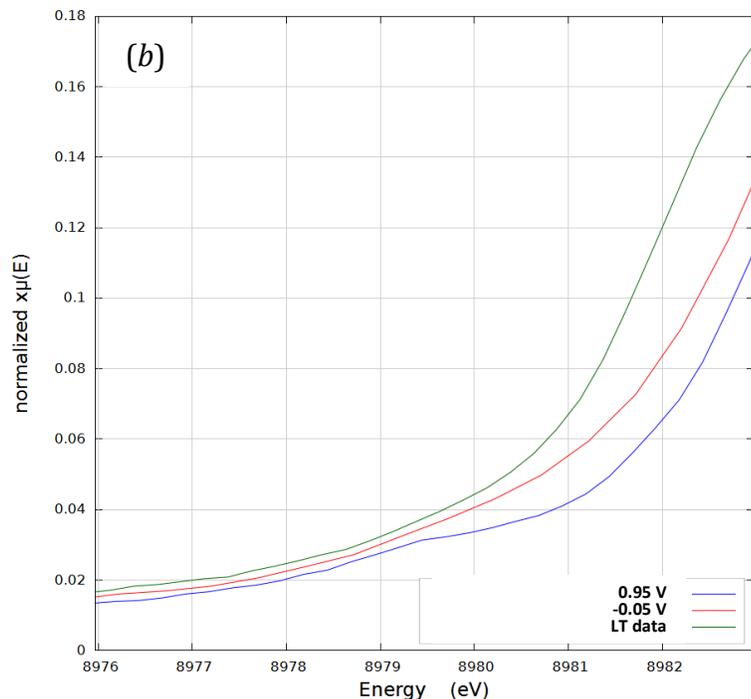




**Figure S4.** (a) XANES-EC region for Cu:A $\beta_{4-16}$  measured at room T and different reducing potentials from -0.15V to -0.45V, and oxidative potential of 1.05 V vs. NHE. For comparison the low temperature (LT) data is also shown. The energy of 8984eV for characteristic Cu<sup>I</sup> peak is indicated by the vertical line. (b) Enlarged section of the plot (a) showing the slight peak at 8979eV at pE=1.05 V.

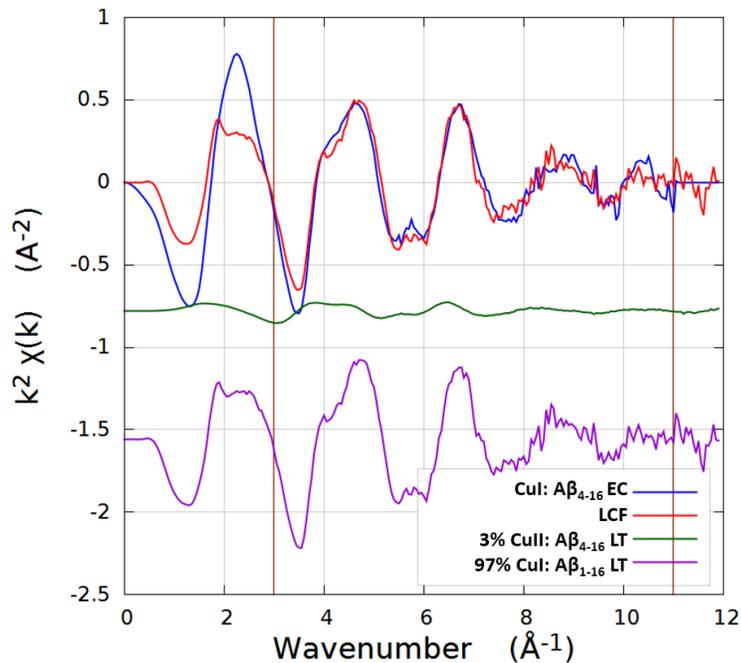


### XANES region for Cu: $\text{A}\beta_{4-12}$



**Figure S5.** (a) XANES-EC region for Cu: $\text{A}\beta_{4-12}$  measured at room T and different reducing potentials from -0.05 to -1.20 V, and oxidative potential of 0.95 and 1.35 V. For comparison the low temperature (LT) data and Cu foil XANES is also shown. (b) Enlarged section of the plot (a) for pE= 0.95,-0.05, and LT data, showing the slight peak at 8979.4 eV at pE=0.95 V.

### Linear Combination Fit (LCF) for Cu: $\text{A}\beta_{4-16}$



**Figure S6.** Linear combination fitting (LCF) to the Cu: $\text{I}:\text{A}\beta_{4-16}$  EC data using our previous unpublished Cu: $\text{I}:\text{A}\beta_{1-16}$  LT (spectra similar to 1) and present Cu: $\text{II}:\text{A}\beta_{4-16}$  LT data as the fitting standards. LCF is based on EXAFS  $k$ -space region (3 - 11 $\text{\AA}^{-1}$ ) marked by vertical lines.

**Statistical F-test.** In order to estimate if the difference between the two models is statistically significant or if one model is significantly better than another, the statistical *F*-test was employed<sup>2-4</sup>. Even though it is rigorously applicable to linear models, the *F*-test should represent a reliable approximation, especially, if the observed  $F_{b,n-m}$  exceed the selected percentage point,  $\alpha$ , of the *F*-distribution:

$$F_{b,n-m} = \frac{\chi_1^2 - \chi_2^2}{\chi_2^2} \frac{n - m_2}{b} \gg F_{b,n-m,\alpha}, \text{ where}$$

$\chi_1^2$  and  $\chi_2^2$  – non-reduced goodness-of-fit  $\chi^2$  from Table 1 for Model 1 and Model 2, respectively;  $b = m_1 - m_2 = (N_{ind} - N_{var1}) - (N_{ind} - N_{var2})$  – degrees of freedom of *F*-distribution;  $n - m_2 = (N_{ind} - N_{var2})$  – degrees of freedom in  $\chi^2_2$ .

The usual criterion for the *F*-test is that  $\alpha = 0.05$ , which means that the improvement in the fit due to including shell is two standard deviations over the noise.

#### REFERENCES

1. Hureau, C.; Balland, V.; Coppel, Y.; Solari, P. L.; Fonda, E.; Faller, P., Importance of dynamical processes in the coordination chemistry and redox conversion of copper amyloid-beta complexes. *J Biol Inorg Chem* **2009**, *14* (7), 995-1000.
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3. Michalowicz, A.; Provost, K.; Laruelle, S.; Mimouni, A.; Vlaic, G., F-test in EXAFS fitting of structural models. *Journal of Synchrotron Radiation* **1999**, *6* (Pt 3), 233-5.
4. Klementev, K. V., Statistical evaluations in fitting problems. *Journal of Synchrotron Radiation* **2001**, *8* (Pt 2), 270-2.