



HAL
open science

Self-assembling proteins for bio-inspired nano-electronics

Joffrey Champavert, Julien Hurtaud, Carole Mathevon, Adeline Jorge-Robin,
Patrice Rannou, Vincent Forge

► **To cite this version:**

Joffrey Champavert, Julien Hurtaud, Carole Mathevon, Adeline Jorge-Robin, Patrice Rannou, et al..
Self-assembling proteins for bio-inspired nano-electronics. Biosensor 2021, Jul 2021, Busan, South
Korea. hal-04829112

HAL Id: hal-04829112

<https://hal.science/hal-04829112v1>

Submitted on 10 Dec 2024

HAL is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers.

L'archive ouverte pluridisciplinaire **HAL**, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d'enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.

Important notes:

Do **NOT** write outside the grey boxes. Any text or images outside the boxes **will** be deleted.

Do **NOT** alter the structure of this form. Simply enter your information into the boxes. The form will be automatically processed – if you alter its structure your submission will not be processed correctly.

Do not include keywords – you can add them when you submit the abstract online.

Title:

Self-Assembling Proteins for Bio-Inspired Nano-Electronics

Authors & affiliations:

Please do not include Personal Data (email address, postal address, etc.) in this field. Include only author names & affiliations

Joffrey Champavert^{1,2}, Julien Hurtaud¹, Carole Mathevon¹, Adeline Jorge-Robin¹,
Patrice Rannou² and Vincent Forge¹

¹ Laboratoire de Chimie et Biologie des Métaux (CBM, AFFOND), team AFFOND, UMR 5249,
CEA-Grenoble, Grenoble, France

² Molecular Systems & NanoMaterialS for Energy & Health laboratory
UMR5819-SyMMES (CNRS/CEA/Univ. Grenoble Alpes), Grenoble, France

Abstract: (Your abstract must use **Normal style** and must fit in this box. Your abstract should be no longer than 300 words. The box will 'expand' over 2 pages as you add text/diagrams into it.)

Preparation of Your Abstract

1. The title should be as brief as possible but long enough to indicate clearly the nature of the study. Capitalise the first letter of the first word ONLY (place names excluded). No full stop at the end.

2. Abstracts should state briefly and clearly the purpose, methods, results and conclusions of the work.

Introduction: Clearly state the purpose of the abstract

Methods: Describe your selection of observations or experimental subjects clearly

Results: Present your results in a logical sequence in text, tables and illustrations

Discussion: Emphasize new and important aspects of the study and conclusions that are drawn from them

Important notes:

Do **NOT** write outside the grey boxes. Any text or images outside the boxes **will** be deleted.

Do **NOT** alter the structure of this form. Simply enter your information into the boxes. The form will be automatically processed – if you alter its structure your submission will not be processed correctly.

Do not include keywords – you can add them when you submit the abstract online.

Bioelectronics is a fast growing research field aiming at mastering the interfacing of biological systems with electronic devices. A highly demanding challenge consists in converting biological signals into an electrical one that can be used by conventional electronic devices. In this context, amyloid fibers, *i.e.* protein nanowires, seem to be good candidates to tackle this challenge as they present many advantages over currently proposed organic (semi)conducting materials. Indeed, they can allow for ionic, protonic, and electronic conductivity. Moreover, they are easy to synthesize, are *tunable by design*, resulting in mesoscopic functional bionanowires with high stability and mechanical properties. They are moreover biocompatible, an important prerequisite when interfacing the living with electronics.

This study focuses mostly on a synthetic redox biofilm made from a metalloprotein–prion domain chimera nanowires. It is known that the HET-s prion domain (218-289), which is found in the fungus *Podospora anserina*, used as a mean of recognizing its pairs, is able to transfer protons through its nanowires at high relative humidity (*e.g.* RH>ca.70%). To allow for electronic transport properties at low relative humidity [1], we envision to functionalize the protein HET with a metalloprotein, rubredoxin (Rd). This led to the resulting chimeric protein called Rd-HET. The prion domain self-assembles into stable and highly organized fibers and provides a suitable arrangement of redox metal centers in Rd to permit electron transport (Figure 1). These bionanowires also can be used as electron transfer mediator for enzymatic electrodes due to the presence of redox centers [2]. The applied chimeric protein strategy resulted in proof of concept demonstrations that one can fine-tune both the electronic and protonic transport features of bionanowires. Our work opens large avenues for further advanced “fusion” of highly seek features, bringing a step closer to reality the advent of a true bio-interfacing of the living with electronics.

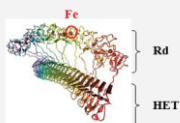


Figure 1 : Structural model of a functionalized amyloid fiber (Rd-HET), each monomer being represented by one color [1].

[1] Altamura L, Forge V et al, Nat. Chem., 2016, vol 8 (2), pp: 157-163

[2] Rengaraj S, Forge V et al, Angew. Chem .Int. Ed., 2017, vol 56, pp : 7774–7778