

SYNTHESIS OF MOLECULAR MEMORY USING METALLPORPHYRINS MONOLAYER ON SILICON SURFACE

Kai HUANG,¹ Guillaume DELAPIERRE,¹ Florence DUCLAIROIR,² Tiziana PRO,³
Barbara DE SALVO,³ Jean-Claude MARCHON,² and Françoise VINET¹

¹*LFCM, Département des microtechnologies pour la biologie et la santé, CEA-DRT-LETI ;*

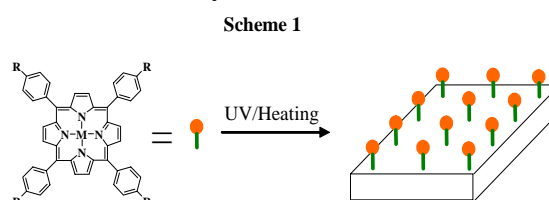
²*SCIB, Département de recherché fondamentale sur la matière condensée, CEA-DSM;*

³*LNDE, Département des Nanotechnologies, CEA-DRT-LETI;*

CEA/Grenoble, 17, rue des Martyrs 38054 Grenoble Cedex 9, France

Kai.huang@cea.fr

1. Introduction. During the past decade there has been intense interest in developing molecular-based electronic materials for use in both memory architectures and circuit elements.¹ Recently, a new approach, the self-assembled monolayers (SAMs) of redox-active porphyrinic molecules attached to an electroactive surface serves as the active storage medium, and information is stored in the discrete redox states of the molecules has been established.² The objective of this research is to fabricate molecular memories



using metalloporphyrins monolayer on silicon surface by different linkers to form uniform and dense active storage medium (**Scheme 1**). One of our current research projects is to anchor metalloporphyrins on Si wafers by covalent Si – C bonding for the fabrication of specifically designed silicon-based devices. To this end we have recently developed a very efficient indirect grafting technique that we are currently optimising.³

2. Experiments. The metalloporphyrins were synthesized at SCIB/DSM/CEA. The metalloporphyrins SAMs was synthesized by different linkers or directly grafted on silicon surface use heating method through different processes and examined by XPS, FTIR, and cyclic voltammetry. The electrode fabrication will be made at LNDE/LETI/CEA and electron-transfer rates and charge-retention time will be determinate.

3. Result. The metalloporphyrins SAM was formed by reaction of TEPPs with azidealkyl monolayer on silicon substrate by “click” chemistry,⁴ and the XPS result (**Figure 1**) shows that N% was increased from 1.46% to 5.29%. At N core-level spectra, the N signal of metalloporphyrins at 398.3 eV can be observed compared with N*-N-N* and N-N*-N signals of azidealkyl at 401 and 404.7 eV, respectively. It suggested that the metalloporphyrins SAM was grafted on silicon substrate successfully. The cyclic voltammograms for ZnAB3P monolayer grafted on Si(100) surface by “click” chemistry was determined. The cyclic voltammograms work is in process in our laboratory.

References:

[1] R. L. Carroll, C. B. Gorman, *Angew. Chem. Int. Ed.* 2002, 41, 4378.

[2] Z. Liu, A. A. Yasseri, J. S. Lindsey, D. F. Bocian, *Science* 2003, 302, 1543.

[3] G. Delapierre, F. Duclairoir, J-C. Marchon *French Pat.* Application No 2005/0510987.

[4] H. C. Kolb, M. G. Finn, K. B. Sharpless *Angew. Chem. Int. Ed.* 2001; **40**: 2004-2021.

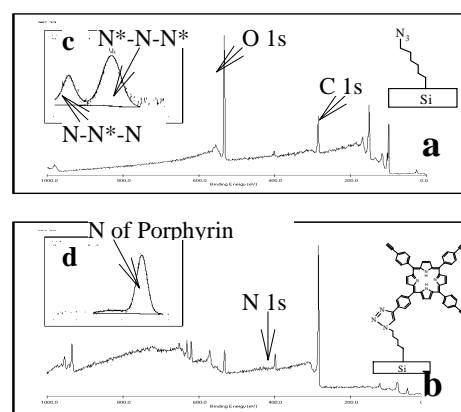


Figure 1. XPS spectra before (a) and after (b) “click” chemistry and the N core-level spectra of azidoalkyl (c) and porphyrin (d) monolayer.