ASSEMBLING A BIOLOGICAL NANOMOTOR ON A NANO-ENGINEERED SURFACE

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Nature offers today thousands of machine at the nano-scale, working in symphony within any living organism on Earth. This basic analysis shows that biology can be seen as a nanoscale phenomenom[1]. Molecular biology, genetics and biochemical methods have been extensively used for studying the structure and principle of these bio-machines from their *in vivo* observations to their *in vitro* extraction and purification. These methods have revealed extraordinary capacities, such as for example the F1F0-ATPase[2]. This nano-motor, presents mechanical and biochemical properties, which are for the moment, out of reach to any nano-scale artificial machine produced by silicon technologies. Since the pioneering work of C. Montemagno[3] a new paradigm has thus been proposed; we call it “Nanotechnologies from biology”. The idea is to integrate natural nanoscale bio-machines on devices in order to exploit their exceptional efficiencies. This methodology can be seen as a rupture with respect to the conventional “top-down” and “bottom-up” approaches, because here, the engineering of the active part of the device is devoted to nature rather than to human conception.

In this paper we describe the initial technological steps dedicated to the assembly of the flagellar nanomotor of bacteria on an artificial engineered surface using nanotechnologies. We will address both questions of the elucidation of the structure and mechanism of this mesoscopic nanomotor and its integration in 2 or 3 dimensions on a solid support. This work is a fundamental research which would serve as a base for the future development of the new area of integrated hybrid bio-inspired devices.

Throug the combination of soft-lithography and self-assembly and using liquid Atomic Force Microscopy for imaging the assembly, we have been able to observe the assembly of one piece of this bionanomachine on a supported phospholipidic bilayer membrane. The structure, the investigation of the interactions between the constitutive proteins of this machine using Quartz Crystal Microbalance technology (QCM) will be reported together with the possible routes untill the complete assembly of this biological nanomachine.

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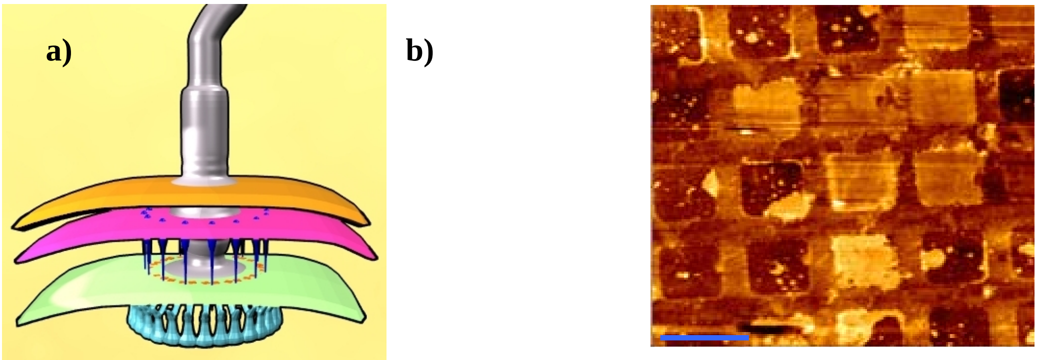
1 « Life as a Nanoscale Phenomenon »,M. Stephen, Angewandte Chemie International Edition 47 (2008) 5306.
2 “The Rotary Machine in the Cell, ATP Synthase”,H. Noji, M. Yoshida, J. Biol. Chem. 276 (2001) 1665.
3 “Constructing nanomechanical devices powered by biomolecular motors”Carlo Montemagno *et al* 1999 *Nanotechnology* **10** 225-231



a) Schematic of the flagellar nanomotor of bacteria. The largest ring at the basis (C-Ring) measures 45 nm in diameter.
b) AFM image in liquid medium of patterned phospholipidic membranes of E. Coli obtained by Micro-Contact printing and selective liposome fusion. Scale bar 5 µm.

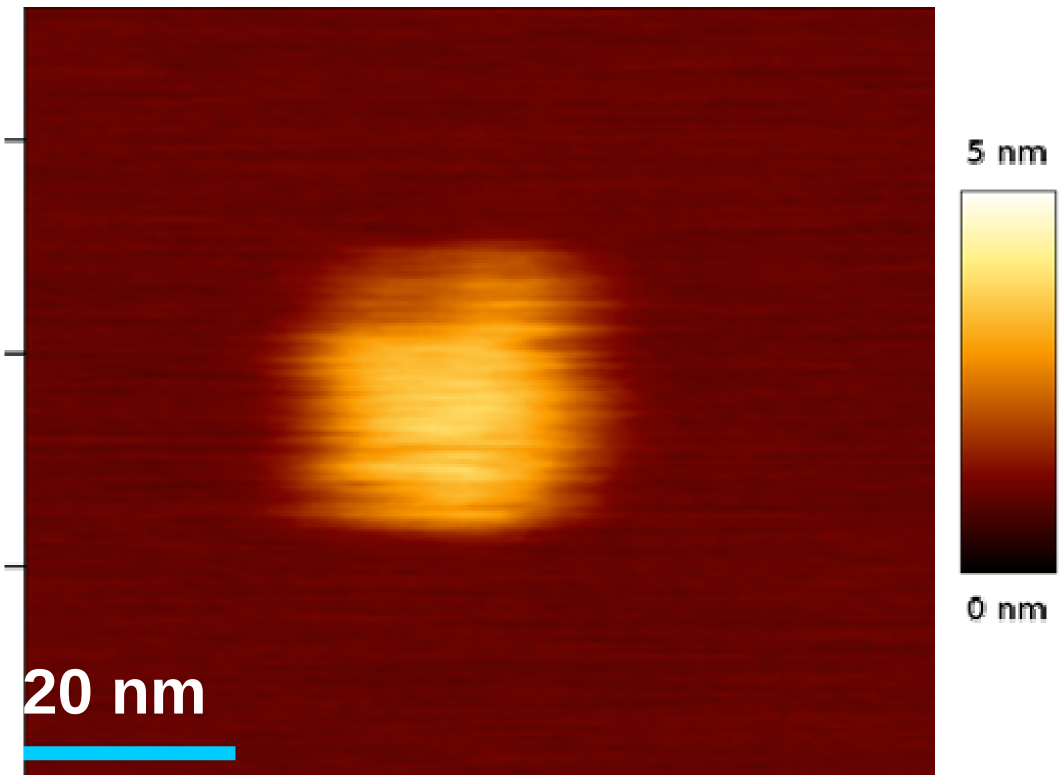


Figure 2 : AFM image in liquid medium of FliG proteins (MS ring) assembled on a supported phospholipidic membranes of E. Coli.