Nanoscaled Biofunctional Interfaces: 
“Orienting” and “Confining” Biomolecules 

by 
Giovanni Marletta 
Laboratory for Molecular Surfaces and Nanotechnology (LAMSUN) 
Dpt of Chemical Sciences - University of Catania and CSGI 
Viale A.Doria 6 - I-95125 Catania - Italy

The need for real breakthroughs in fields like biomaterials and biocompatible surfaces, molecular electronics and bioelectronics, sensor and biosensors, etc., triggered an enormous effort in developing strategies for nanoscaled structures, capable of conferring smart properties to biointerfaces. In particular, strategies for biomolecule nanopatterning are expected to play a critical role in addressing crucial aspects of nanomedicine of the future, such as the nanoscale control of surface-cell interaction, the development of “right” density sensing arrays, cell-localized drug delivery, etc…

The basic underlying idea is that confining biofunctional compounds in nanosized structures may prompt unprecedented selectivity and efficacy in disease diagnostic and therapy.

In this perspective, the control of crucial factors like the “organization”, including density and spatial arrangement, and the “orientation/conformation” of biomolecules at the biological medium/synthetic interfaces is increasingly seen as the critical success factor to transfer successful solution-like approaches to the realm of efficient biomedical devices.

The present Lecture reports on some approaches aimed to achieve “non-perturbing” anchoring of biomolecular systems, including oligopeptides, oligonucleotides and proteins, onto surfaces functionalised to privilege the proper “orientation” or distribution of the biomolecules. In particular, a number of “soft” approaches will be reported about the possibility of obtaining, respectively, the desired orientation/conformation of anchored biomolecules, including surface-driven oligopeptide organization (fig.1) and protein orientation at surfaces,

![Figure 1](image1.jpg)

**Figure 1 – Surface-dependent organization of self-complementary EAK-16 oligopeptides.**

and biomolecule spatial distribution, dealing with space-confined protein trapping by means of complexing processes, Langmuir-Blodgett film nanopatterning, selective protein trapping in nanomcontainers at macromolecular surfaces (fig.2).

![Figure 2](image2.jpg)

**Figure 2 – Protein trapping within hybrid polymer/gold nanocontainers (scale 2 µm): A) “empty” nanocontainers; B) after exposure to “large” fibronectin; C) after exposure to “small” Human Serum Albumin.**
Techniques to address the problem of determining the orientation of complex biomolecular systems, including ex-situ techniques, as Time of Flight Secondary Ion Mass Spectrometry (ToF-SIMS), and in situ techniques, as Localized Surface Plasmon Resonance (L-SPR) and Quartz Crystal Microbalance (QCM-D) will be shortly discussed, along the relevant physico-chemical factors involved in the control of the possibility of complex systems as oligonucleotides and oligopeptides to adopt the profitable conformations needed to keep the desired biological functions.