

EDITORIAL

Open Access

# The new faces of biointerfaces?

Ilya Reviakine<sup>1</sup>

*The nature of living things is to change*

This year's *Biological Surfaces and Interfaces*, or *Biointerfaces*, meeting that took place between the 30th of June and the 5th of July, 2013 in Sant Feliu de Guixols (Spain), [1] was different.

It was the latest in the series of meetings covering ... *interfaces between synthetic materials and biological systems or within biological systems – biointerfaces...* These meetings took place every other year between 2003 and 2013. By providing a unique interdisciplinary forum for an eclectic group of researchers to exchange ideas, they became an integral part of the process of forging of a new field. Each meeting incorporated a Forward Look session, where the grand challenges facing the field were discussed. The discussion was moderated by a panel of senior and young scientists. With the shifting priorities at the European Science Foundation, a long-time sponsor, the longevity of this very successful and stimulating event is in danger. Indeed, it is only thanks to the quick action of the current chairs, Ralf Richter and Catherine Picart, that the support from FEBS and other sources could be secured for the 2013 meeting.

Historically, the biointerfaces community was nucleated by the surface scientists who took the bold step from ultra-high vacuum (UHV) into liquid, [2] driven by the desire to find out at the molecular level what goes on when biological systems encounter artificial surfaces, and by the idea that surface science methodologies could provide a unique perspective on interfaces that occur in the biological world. Over the years, it has crystallized around these two underlying concepts that propelled the field forward, fostering collaborations between biologists and material scientists—the all important human factor—as well as the appearance of new techniques for designing and studying dynamic, hydrated biological interfaces: what could be called “a biosurface science toolbox” [3]. Inspiration came from numerous

challenges—organizing molecules and cells at interfaces, understanding how cells interpret chemistry, topography, and stiffness; designing selective sensors; controlling/restricting non-specific interactions between surfaces and biomolecules; and understanding biocompatibility—to name a few. An insightful historical perspective can be found in M. Grunze's editorial written for the opening of a new journal, *Biointerphases* [2]. Similarly, B. Kasemo's review *Biological Surface Science* continues to inspire generations of young scientists [3]. I have also selected several references to illustrate how some of the techniques and approaches from the toolbox gained wider acceptance [4-12] and fostered conceptual advances in disparate research areas; [13-17] the selection is meant to be illustrative rather than exhaustive.

In previous years, artificial surfaces, bio/non-bio interfaces, and the surrounding tools, were very much present as a unifying concept of the meetings. They did not make such a center stage appearance in 2013. Featured prominently in their stead were the concepts surrounding the extracellular matrix, intercellular communication, and the interactions between cells and the extracellular matrix. What is behind this shift in focus? Have we solved all the problems, is it time to move on and do something else? Not likely. The Forward Look session of 2011 focused on a number of challenges that included 3D cell culture tools, interactive, “smart” interfaces, quantifying biological responses, [18] uncovering the simple underlying principles (the “Bohr atom” or the “Ising model”) of biointerfaces, water structure at interfaces, and biocompatibility. These challenges are still there. Blood compatibility catastrophe [19,20] is still exactly that, [21] modern interfaces are as simplistic as ever (as opposed to intelligent/self-healing/self-replicating), and any discussion of interfacial water brings smiles to the faces of most scientists. Yet the community appears to be melting in the process of searching for a new identity.

In my view, there are two currents underlying this process. On the one hand, the surface-science driven approach has reached a plateau of sorts on the technical front. We need new ways of looking at interfaces, ways that will radically change our current views. That will

Correspondence: Ilya.Reviakine@kit.edu

<sup>1</sup>Institute for Functional Interfaces (IFG), Karlsruhe Institute of Technology (KIT), Hermann-von-Helmholtz-Platz 1, 76344, Eggenstein-Leopoldshafen, Germany

Full list of author information is available at the end of the article

surely be realized in the future with some sort of a new technique that is probably already brewing in someone's laboratory. On the other hand, and this is much more important, it is becoming apparent that the answers to the half-a-century old questions of how cells see artificial surfaces just might come from understanding the language cells use to communicate with each other. We need to learn their alphabet. Decrypt their ciphers and eavesdrop on their conversations. Figure out who is talking to whom and what they are saying. How the biointerfaces community will take on this challenge, how will cross-fertilization with the biosurfaces/bio-compatibility topics occur, and what will become of the community in process, will surely be interesting to see.

Topic evolution aside, the Biointerfaces meetings have always had one unique feature: they provided an interface between scientists from different, often exceedingly diverse, fields. Scientists who were trained to speak different languages but saw the benefit of venturing into the great unknown of the foreign "speak". This has been aided by the particular organization of the meetings, and it is poised to continue into the future. Thanks to this aspect, these meetings are very much likely to continue serving their role as a center stage for new ideas whatever the direction in which these ideas evolve.

#### Competing interests

The author declares that he has no competing interests.

#### Acknowledgements

The author acknowledges Dr. Ralf Richter and Ms. Danijela Gregurec (both at CIC biomaGUNE, San Sebastian, Spain) for enlightening discussions.

#### Author details

<sup>1</sup>Institute for Functional Interfaces (IFG), Karlsruhe Institute of Technology (KIT), Hermann-von-Helmholtz-Platz 1, 76344, Eggenstein-Leopoldshafen, Germany. <sup>2</sup>Faculty of Engineering, the University of the Basque Country (UPV/EHU), Alameda Urquijo s/n., 48013, Bilbao, Spain.

Received: 11 September 2013 Accepted: 9 October 2013

Published: 18 October 2013

#### References

1. More information about the meeting can be found at <http://www.esf.org/index.php?id=9738> Accessed October 4th, 2013
2. Grunze M, Exarhos G (2006) A surface scientist's perspective on Biointerphases, or "Out of the Vacuum, into the Liquid". *Biointerphases* 1:CL1-CL2
3. Kasemo B (2002) Biological surface science. *Surf Sci* 500:656-677
4. Cho NJ, Frank CW, Kasemo B, Hook F (2010) Quartz crystal microbalance with dissipation monitoring of supported lipid bilayers on various substrates. *Nat Protoc* 5:1096-1106
5. Reviakine I, Johannsmann D, Richter RP (2011) Hearing what you can't see and visualizing what you hear: interpreting quartz crystal microbalance data from solvated interfaces. *Anal Chem* 83:8838-8848
6. Kraft ML, Weber PK, Longo ML, Hutcheon ID, Boxer SG (2006) Phase separation of lipid membranes analyzed with high-resolution secondary ion mass spectrometry. *Science* 313:1948-1951
7. Michel R, Pasche S, Textor M, Castner DG (2005) Influence of PEG architecture on protein adsorption and conformation. *Langmuir* 21:12327-12332
8. Lee BP, Messersmith PB, Israelachvili JN, Waite JH (2011) Mussel-Inspired Adhesives and Coatings. *Annu Rev Mater Res* 41:99-132

9. Falconnet D, Csucs G, Grandin HM, Textor M (2006) Surface engineering approaches to micropattern surfaces for cell-based assays. *Biomaterials* 27:3044-3063
10. Reviakine I, Brisson A (2000) Formation of supported phospholipid bilayers from unilamellar vesicles investigated by atomic force microscopy. *Langmuir* 16:1806-1815
11. Richter RP, Berat R, Brisson AR (2006) Formation of solid-supported lipid bilayers: An integrated view. *Langmuir* 22:3497-3505
12. Castellana ET, Cremer PS (2006) Solid supported lipid bilayers: From biophysical studies to sensor design. *Surf Sci Rep* 61:429-444
13. Bouter A, Gounou C, Berat R, Tan S, Gallois B, Granier T, d'Estaintot BL, Poschl E, Brachvogel B, Brisson AR (2010) Annexin-A5 assembled into two-dimensional arrays promotes cell membrane repair. *Nat Commun* 2:270
14. Cavalcanti-Adam EA, Volberg T, Micoulet A, Kessler H, Geiger B, Spatz JP (2007) Cell spreading and focal adhesion dynamics are regulated by spacing of integrin ligands. *Biophys J* 92:2964-2974
15. Discher DE, Mooney DJ, Zandstra PW (2009) Growth factors, matrices, and forces combine and control stem cells. *Science* 324:1673-1677
16. Frisz JF, Lou KY, Klitzing HA, Hanafin WP, Lizunov V, Wilson RL, Carpenter KJ, Kim R, Hutcheon ID, Zimmerberg J, Weber PK, Kraft ML (2013) Direct chemical evidence for sphingolipid domains in the plasma membranes of fibroblasts. *Proc Natl Acad Sci U S A* 110:E613-E622
17. Groves JT, Dustin ML (2003) Supported planar bilayers in studies on immune cell adhesion and communication. *J Immunol Methods* 278:19-32
18. Hook F, Kasemo B, Grunze M, Zauscher S (2008) Quantitative biological surface science: challenges and recent advances. *ACS Nano* 2:2428-2436
19. Ratner BD (1993) The blood compatibility catastrophe. *J Biomed Mater Res* 27:283-287
20. Ratner BD (2007) The catastrophe revisited: Blood compatibility in the 21st century. *Biomaterials* 28:5144-5147
21. Ratner BD (2011) The biocompatibility manifesto: biocompatibility for the twenty-first century. *J Cardiovasc Transl Res* 4:523-527

doi:10.1186/1559-4106-8-26

Cite this article as: Reviakine: The new faces of biointerphases?. *Biointerphases* 2013 **8**:26.

Submit your manuscript to a SpringerOpen® journal and benefit from:

- Convenient online submission
- Rigorous peer review
- Immediate publication on acceptance
- Open access: articles freely available online
- High visibility within the field
- Retaining the copyright to your article

Submit your next manuscript at ► [springeropen.com](http://springeropen.com)