Biointerphases
a SpringerOpen Journal

EDITORIAL Open Access

The new faces of biointerfaces?

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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

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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/biocompatibility 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.

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Received: 11 September 2013 Accepted: 9 October 2013
Published: 18 October 2013

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doi:10.1186/1559-4106-8-26
Cite this article as: Reviakine: **The new faces of biointerfaces?.** *Biointerphases* 2013 **8**:26.