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Editorial

Editorial introduction to the special issue on bio(nano)materials with structure–property relationship

Biomaterials, with their underlying physicochemical characteristics, have become a topic of very intense research activity for many years. These activities include research on Langmuir–Blodgett films, and then bioorganic thin films (since the 1940s), studies on amphiphilic micellar and multilayered systems (since the 1950s), and finally, modern technological, basic and applied research on soft-material crystals (protein or other bioorganic) and amorphous-polycrystalline aggregates, such as modern biomembranes and adhesive layers (since the 1960s and 1970s).

Today, a thorough exploration of biomaterials down to the nanoscale ($1\ \mathrm{nm} = 10^{-9}\ \mathrm{m}$) becomes feasible because of the systematic advancement in developing truly sophisticated experimental methods. These methods are based mainly on neutron, X-ray, light scattering and diffraction methods, as well as on many spectroscopic techniques supporting them, including atomic force microscopy/spectroscopy, or Raman spectroscopy. In addition, current computers are equipped with large memory and well-developed software. Moreover, the computers themselves, with the properly designed software, offer a sophisticated means toward expanding the field of computer simulations. Simulation can be a very good and relatively cheap companion to any real laboratory experiment.

As expected, the not-mentioned-yet analytical and theoretical methods are mainly aimed at maintaining the pace and direction of modern-era bionanomaterials research and its well-documented advance. They are customarily used to examine bionanomaterials, thus being often not too close to reality, but regardless, they provide a general reference frame to follow.

It is argued that bionanomaterials are recognized as complex and often nonlinear viscoelastic and stochastic systems, with their basic properties subjected to some changes at the nanoscale level. Here, one can, for example, think of reduced-friction and strong-adhesion systems, the particular properties of which depend upon surface detail, such as roughness profile, or a type of interaction between the selected coupled pair of rubbing surfaces, and the like. Therefore, examining a well-defined structure–property relationship, or paradigm, can serve thoroughly as an as-yet not satisfactorily explored way of deriving the principal characteristics of bio(nano)materials.

The material collected in this Special Issue exemplifies the above invoked structure–property relationship, which is expected to hold at certain classes of (model) biosystems having soft-material characteristics, in particular those with dynamic, permeative, friction–adhesion or matter-aggregation properties. The particular character of the material selected rests upon the fact that it was mainly, except of a few invited contributions (which also went independent review), collected at an International Symposium on Bionanomaterials that was held at the Silesian University of Technology (S.U.T.) in Gliwice, Poland, 10–11 March 2008 (http://mer.chemia.polsl.pl/ZJG60/).

The main goal of the meeting was to explore by examples the bio(nano)material structure–property relationship. The specific goal of the symposium was to honor the scientific activity of one of the leading soft-matter researchers in Poland, Professor Zbigniew J. Grzywna from S.U.T. Gliwice, by celebrating his 60th birthday. The versatile research activities of Prof. Grzywna may be viewed in qualitative scaling-concept related terms as the ones advocating strongly for the soft-matter physics vision of Prof. Pierre-Gilles De Gennes (1932–2007), the 1991 Nobel Prize laureate in physics. (De Gennes' ideas are present this year in Paris at the College de France, during the so-called De Gennes Days http://www.fondation-pgg.org/events/degennesdays/uk/degennesdays.php, proclaimed as a matter of further active continuation.)

The offered Special Issue consists of 18 thoroughly reviewed contributions. (Let us thank cordially numerous anonymous reviewers for their patience and merits towards improving substantially the reviewed submissions.) The contributions can be divided into six subcategories. These are as follows: (i) protein (collective) dynamics, involving confinement, stochastics and chemical reaction; (ii) protein and amphiphile (dis)orderly aggregation; (iii) ion and/or molecule channels and intermicellar passages through dynamic structures of protein or lipid assemblages; (iv) friction and adhesion in (bio)systems; (v) (anti)cancer cell systems as specific indicators of biomaterial's failures; (vi) biosystems as seen from more macroscopic and behavioral points of view, with motivated implications toward nanoscale. The most numerous contributions can be assigned to subcategory (iv), i.e. five articles (Pawlak & Oloyede; Pawlak et al.; Beldiman et al.; Pugno & Lapore; Gadomski). Subcategory (ii) contains four articles (Siódmiak; Pechkova et al.; Nicolini et al.; Gadomski), then group (i) includes three articles by Wojciechowski & Cieplak; Machura, Kostur & Łuczka; and Wybranowski et al. The remaining groups (iii), (v) and (vi) contain in total six papers—each of them has two papers included: Olszewski & Nowak and Borys & Grzywna in group (iii); Ziomkowska & Kruszewski and Borys et al. in group (v), and finally, Bosek and Dudek et al. in group (vi).

Let us hope that the offered material, the collection of which could not have been entirely possible without active

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help and generous assistance of Dr. Monika Krasowska (Gliwice) and Prof. Zuzanna Siwy (Irvine), as well as of technical and reviewing-matter concerning support by Mrs. Natalia Kruszewska (Bydgoszcz), will induce a stream of further fascinating research at the edge of biomaterial's structure and basic property, both of them being examined in the nanoscale. Practical aspects of the presented material in the areas of nanotechnology, biotechnology, pharmacology, and biomedical sciences should also be indicated.

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