frontiers in Mechanical Engineering

EDITORIAL
published: 09 April 2020
doi: 10.3389/fmech.2020.00017

Editorial: Biotribology and Biotribocorrosion Properties of Implantable Biomaterials

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Keywords: biotribology, biotribocorrosion, biomaterials, surface modification, *in-silico* models, biomechanical models

Editorial on the Research Topic

Biotribology and Biotribocorrosion Properties of Implantable Biomaterials

This special issue was conceived with the aim to give to the readers the opportunity to focus their attention on some recent and relevant scientific issues in the field of Biotribology and Biotribocorrosion, which represents nowadays one of the most interesting areas of Tribology applied to the study of biological systems. The word "biotribology" was introduced by Dowson in 1970 as "those aspects of tribology concerned with biological systems" (Dowson, 1970; Zhongmin et al., 2020) and represents a fascinating multidisciplinary Research Topic, focused on the study of friction, wear and lubrication of natural and artificial synovial joint, wear of dentures, ocular tribology, wear of cardiac valves and lubrication of artificial heart pumps, tribology of artificial screws and plates against natural bone, comfort of clothes, tribology for assessing mouthfeel attributes of foods, etc. (Jin et al., 2006). When the combined effects of wear and corrosion due to the biological environments are considered, biotribocorrosion takes place. In this scenario the biotribology and the biotribocorrosion properties of modern implantable biomaterials are extremely important, especially for the situations where there is relative movement between the implanted biomaterials or between the implanted biomaterial and the natural tissues under physiological environment. This is the case for example of the Total Knee Replacements (TKR) or Total Hip Replacements (THR) which represent one of the most investigated bio-tribological system due to their growing diffusion in all the world (Kurtz, et al., 2007; Learmonth et al., 2007). In TKR and THR wear phenomena play a key role, since one of the main failure reasons are dislocation due to debris particles entrapped in human tissues leading to metallosis and osteolysis conditions (Kaddick et al., 2009; Zivic et al., 2017). With the aim to improve the tribological design of such components, preclinical *in-vitro* wear tests by knee and hip simulators has become a standard procedure for achieving a performance assessment and for investigating experimentally the tribological phenomena acting on the contact surfaces during a simulated motion in a controlled lubricating environment (Abdel-Jaber et al., 2015). However, these tests are expensive and require long time, since the simulations run for several million cycles, taking in to account that one million cycles is assumed to correspond to 1 year *in-vivo* conditions. Considering the above, to date, *in-silico* wear prediction models of artificial human implants attract the attentions of researchers to obtain complete tribological theoretical and numerical models useful for the *in-silico* testing (O'Brien et al., 2015; Mattei et al., 2016; Affatato et al., 2018), which could avoid the standard *in-vitro* time-consuming investigation procedures (simulators) and could contribute as tool for a more and more accurate tribological design of human prostheses. Obviously, the accurate wear prediction of artificial joints requires to develop detailed tribological models accounting for

Edited and reviewed by:
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Specialty section:
This article was submitted to Tribology, a section of the journal Frontiers in Mechanical Engineering

Received: *27 February 2020*
Accepted: *16 March 2020*
Published: *09 April 2020*

Citation:
Ruggiero A and Zhang H (2020) Editorial: Biotribology and Biotribocorrosion Properties of Implantable Biomaterials. Front. Mech. Eng. 6:17. doi: 10.3389/fmech.2020.00017

the complexity and the multiscale of wear phenomenon (Vakis et al., 2018) which requires scientific knowledge in many fields, such as contact mechanics (Popov, 2010), topographic contact surfaces characterization (Merola et al., 2016), new materials formulations (Affatato et al., 2015), stress-strain analysis and FEM/BEM simulations (Ruggiero et al., 2018; Ruggiero and D'Amato R, 2019), musculoskeletal multibody modeling (Zhang et al., 2017), unsteady synovial lubrication modeling (boundary/mixed, hydro-dynamic and EHD) (Ruggiero and Sicilia, 2020), tribo-corrosion (Tan et al., 2016), metal transfer phenomena (Affatato et al., 2017), biomaterials characterizations (Ruggiero et al., 2016), etc. Moreover, innovative biomaterials and manufacturing procedures (e.g., 3D printing), novel surface modification (coatings) constitute new and exciting research areas (Ten Kate et al., 2017).

In this framework this special issue aims to inspire colleagues and scientists collecting interesting research papers investigating the THR wear of CoCrMo femoral heads, against conventional and X-linked ultra-high molecular weight polyethylene (UHMWPE) acetabular cups (Hua et al.) as well review papers regarding the synergetic therapy combining lubrication and drug intervention, regulatory balance between bone resorption and formation, and exercise therapy (Ji and Zhang, 2019) and the latest technologies in the field of joint arthroplasty, such as osseointegration of artificial joints, the improvement of materials with the property of osteoimmunomodulation reviewing the improvement of joint arthroplasty technologies based on the modeling of dynamic osteosynthesis, as well as the identification of possible unconventional designs of artificial joints that contribute to these technologies, predictive assessment of areas for technologies improvement (Poliakov et al.). Moreover, attention was paid to review recent and relevant researches regarding the bio-tribo-corrosion phenomena in the oral rehabilitation devices summarizing clinical problems and advances obtained based on current scientific evidences in the framework of the tribological fundamentals, testing methodologies, and protocols in tribo-corrosion analyses (Dini et al.).

We hope that the readers will find interesting insights in the published paper in this special issue and finally we would like to thank all authors for their valuable contributions, the involved and the Specialty Chief Editor(S) Roman Pohrt and Valentin L. Popov for their support during the entire process.

AUTHOR CONTRIBUTIONS

All authors listed have made a substantial, direct and intellectual contribution to the work, and approved it for publication.

ACKNOWLEDGMENTS

The authors acknowledge financial support of the Italian Research Project PRIN 2017 BIONIC-MIUR and National Natural Science Foundation of China (51675296).

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Conflict of Interest: The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.