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Christopher M. Madl,
University of Pennsylvania, United States

*CORRESPONDENCE
Chun Wang,
wangx504@umn.edu

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Editorial: Celebrating 1 year of frontiers in biomaterials science

Chun Wang[1]* and Virginia Brancato[2]

[1]Department of Biomedical Engineering, College of Science and Engineering, University of Minnesota, Minneapolis, MN, United States, [2]Department of Biotechnology and Biosciences, School of Sciences, University of Milano-Bicocca, Milano, Lombardy, Italy

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Editorial on the Research Topic
Celebrating 1 year of frontiers in biomaterials science

We are delighted to introduce the Research Topic to commemorate the first year of our new journal, Frontiers in Biomaterial Science. The Journal aims to dissect the old and new biomaterials, bridging the gap between different disciplines, such as chemistry, biology physics and biomedical engineering.

The Research Topic includes five high-quality articles covering several highly important topics in biomaterials science today: functional hydrogels, biodegradable metals, and biomaterial recycling for sustainable development.

Hydrogels are three dimensional networks of hydrophilic polymers crosslinked through physical or chemical bonds. They are incredibly useful biomaterials in many areas, including stimuli-sensitive matrices for controlled drug release, functional therapeutic materials for tissue repair and regeneration, and artificial tissue/disease models. Three articles in this Research Topic are dedicated to these topics.

Minehan and Del Borgo, have presented an in-depth review on enzyme-responsive hydrogels and how they are designed for controlled, on-demand release of therapeutics. The authors organize their review along three different mechanisms of drug release from enzyme-responsive hydrogels: (1) matrix degradation followed by drug diffusion, (2) cleavage and release of drugs after nonspecific enzymatic action, and (3) cleavage and release of drugs from linkers by targeted (specific) enzymatic action. Numerous recent examples that embody these mechanisms of action are described and analyzed. Finally, the authors provide insightful comments on the future prospect of developing enzyme-responsive hydrogels for drug delivery and the challenges and opportunities for clinical translation.

Gultian et al. have showcased injectable hydrogels functionalized with bioactive peptides for stimulating the growth of bone tissue. The researchers have focused on hyaluronic acid (HA), a very common natural biopolymer and an important component of the extracellular matrix (ECM). An elaborate chemical conjugation scheme is designed to produce injectable "click" hydrogel from peptide-functionalized HA precursors. These functional hydrogels have shown the capacity of stimulating bone-forming activity of mesenchymal stem cells (MSCs) and enhancing the repair of bone defect in an *in vivo* model. By optimizing different peptide combinations and mechanical properties, these hydrogels can be further perfected to become highly effective materials for treating diseases such as osteoporosis.

Hydrogels are the materials of choice for constructing *in vitro* models that recapitulate the physiological and pathological states of biological tissues. Such models are useful in drug

screening and mechanistic understanding of diseases. Northcutt et al. report on hydrogels that recapitulate certain biochemical and biomechanical aspects of the bone marrow. These gels consist of alginate, a polysaccharide from algae, and Matrigel, a biologically derived ECM mixture. The mechanical stiffness of the gels is tuned to match that of the bone marrow by adjusting the degree of crosslinking of the alginate, whereas the cues for cell adhesion and migration are provided by the Matrigel. This artificial bone marrow is a useful tool for elucidating the roles of matrix mechanics in regulating cancer cell invasion and metastasis.

Two articles in this Research Topic consider the Research Topic of material degradation from different angles. Sefa et al. focus on the therapeutic effect of biodegradable metals. They notice that there is a lack of understanding of the long-term *in vivo* consequences of biodegradable magnesium-based metal alloys for orthopedic applications. Such information is critical to the clinical success of Mg-based implants. To this end, the authors implanted three Mg alloys in the femur of rabbit and used high resolution synchrotron radiation micro computed tomography to examine the level of bone growth in response to the implants.

Biodegradable or bioresorbable materials are also desirable for the sake of sustainable development, a topic often overlooked by the biomaterials research community. A mini review by Wiśniewska et al. is dedicated to this important topic, providing "a brief overview, analysis, and classification of reports on biomaterials recycling."

The Research Topic aims to celebrate the first year of the new journal, Frontiers in Biomaterials Science. By covering different approaches in biomaterials, we invite the reader to explore a broad range of ideas and possibilities of the use of novel materials in different fields.

Author contributions

CW: Writing–original draft, Writing–review and editing. VB: Writing–review and editing.

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.

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