

Preface

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Emerging technologies for a more sustainable future

Preface for emerging technologies and new directions in chemistry research

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Many demanding challenges threaten mankind. Chemical processes and products are indispensable for limiting global warming to 1.5° and managing its consequences, fighting the Covid and other pandemics, and providing enough food to eliminate hunger globally. However, our existing technologies are not sufficient for this. New technologies must be identified and transformed into innovations to successfully overcome these challenges [1]. What are these emerging chemical technologies? Which are the new directions chemistry will go in future?

To identify these, in 2019 IUPAC introduced the “Top Ten Emerging Technologies in Chemistry”, commemorating both IUPAC’s centenary and the International Year of the Periodic Table, a worldwide event that celebrated 150 years since the first publication of Mendeleev’s most famous chemistry icon. The “Top Ten Emerging Technologies in Chemistry” are also aligned with the United Nations’ Sustainable Development Goals. The selected technologies will change our world for the better, making a more thoughtful use of our resources, favoring more efficient transformations, and providing more sustainable solutions in a wide variety of applications.

Every year, the “Top Ten Emerging Technologies in Chemistry” will identify innovations with major potential to change the current chemical and industrial landscape. The selections for 2019, 2020, and 2021 were published in *Chemistry International* [2–4]. Chemists around the globe have suggested remarkable technologies and innovations in their respective fields and a team of experts, recruited by IUPAC, have studied the proposals and selected the most disruptive, forward-thinking, and promising ideas, which show the greatest chances of success. Some of these have already started weaving a network of spin-offs and attracting the interest of chemical enterprises.

Here, we publish three articles as examples from the 2019 and 2020 selections: Chemists have always been inspired by nature. Organocatalysts, like most natural enzymes, do not require the use of expensive metals; a technology that has been recognized this year with the award of the Nobel Prize in Chemistry. Chemical

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processes, especially biochemical pathways, are often limited by downstream process technologies. Liquid gates can selectively process mixtures of fluids without clogging and become useful for large-scale filtration and separation processes. Nowadays, luminescent materials are ubiquitous: from LEDs to bio-imaging techniques. Aggregation-induced emission has transformed the way people think about luminescence. Our 2020 list includes RNA vaccines, a technology that is having a pivotal role in fight against the Covid pandemic.

During the centenary celebration of IUPAC in 2019 in Paris, the Council made a decision to undertake organizational structure change to meet the global challenges in the new era. A review group led by Dr. Mark Cesa had been established for the purpose. It has become clear that IUPAC should focus on scientific affairs, instead of administrative ones. Dr. Cesa proposed carrying out a comprehensive review on the frontiers of chemistry. A group of young scientists from China has taken this challenging task. These efforts led to seven review articles covering frontiers of synthetic chemistry, catalysis and interface chemistry, chemical theory and mechanism, materials chemistry and energy chemistry, chemical detection and measurements, chemical biology, and environmental chemistry. It should be pointed out that all the corresponding authors are under the age of 35. Their opinions might not be comprehensive, but certainly represent most of the emerging chemical research directions. It was decided to group three articles from “Top Ten Emerging Chemical Technology” and seven articles from the survey on “frontiers of chemical research” for this special issue. It is intended to publish other articles in these areas in *Pure and Applied Chemistry* in the future.

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