Steps of fronts in chemical engineering: An overview of the publications of *FCSE*

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The fronts of a subject could be perceived from the publications of top journals. We investigated four top journals on chemical engineering: *AIChE Journal*, *Chemical Engineering Science*, *Industrial & Engineering Chemistry Research* and *Chemical Engineering Journal*. Based on Web of Science, in the last five years, these four journals have published 21062 papers, including 590 highly cited papers and 31 “hot” papers among which only 7 are from *Industrial & Engineering Chemistry Research* and all the others from *Chemical Engineering Journal* (data obtained on November 17, 2018). The traditional research “Pure and pseudo-pure fluid thermophysical property evaluation and the open-source thermophysical property library CoolProp” is the most cited paper published in 2014 [1]. Both highly cited and “hot” papers were published in 2017 on electrodes of supercapacitors [2]. But researches on environmental science and engineering have been paid most attention with 17 of 27 both highly cited and “hot” papers on this research area. The most cited and “hottest” paper is “Boron nitride-based materials for the removal of pollutants from aqueous solutions: A review” in 2018 [3].

Over the past decades, research and technologies advancement in chemical science and engineering in China has expanded in a lightning speed globally. To meet the growing needs of knowledge exchange and understanding of the underlying scientific principles, we launched in 2007 a new journal named *Frontiers of Chemical Engineering in China* with all papers translated from the Chinese journals. Original research articles or reviews have been published since 2009. The new name *Frontiers of Chemical Science and Engineering (FCSE)* has begun only since 2011 and *FCSE* became one of the Transactions of the Chinese Academy of Engineering (CAE) in 2014. From CAE, we have received many supports, both academic and financial. Especially in the latest three years, we have organized some important Special Issues and Topics.

For the keywords given by authors or Web of Science (Fig. 1), “Carbon, Acid, Oxide, Oil, Metal, Cell, Drug, Catalyst, CO₂, CO, Membrane, Hydrogen, Process, Crystal, Gas...” appear more frequently, indicating that “environment, sustainable, bio-, medical, and catalysis” are hot topics in *FCSE*.

1 Environmental & sustainable is indeed a hot topic

Unlike the most of “hot” papers in *Chemical Engineering Journal* mainly on treating waste water, two Reviews on CO₂ published in *FCSE* are the most cited papers. Prof. Gong has reviewed the utilization of carbon dioxide by catalytic reactions, focusing on recent developments in catalytic materials, novel reactors, and reaction mechanism for methanation of CO₂ [4]. In 2015, Prof. Stevens contributed “Review of solvent based carbon-dioxide capture technologies” as a Cover Paper. This review updated the status of large scale integrated carbon capture and storage technologies using solvent absorption for CO₂ capture and provided an insight into the development of new solvents, including advanced amine solvents, amino acid salts, carbonate systems, aqueous ammonia, immiscible liquids and ionic liquids. These proposed new solvents aim to reduce the overall cost of CO₂ capture by improving the CO₂

Fig. 1 Word cloud of the (left) Authors-Keywords and (right) Web of Science Keywords-Plus 2011–2018

absorption rate, CO₂ capture capacity, thereby reducing equipment size and decreasing the energy required for solvent regeneration [5].

In 2016, we hosted “2016 Symposium on Frontiers of Chemical Science and Engineering—Environment and Sustainable Development” [6]. In this conference, we invited some of the speakers and relevant scientists contributing to the Special Topic on environment and sustainable development. Prof. John C. Crittenden et al. gave a Views & Comments on the symposium [7]. Four groups made their contributions as Reviews and nine groups presented their latest research results in this Special Topic. Prof. Allen himself wrote the paper “Combining innovative science and policy to improve air quality in cities with refining and chemicals manufacturing: The case study of Houston, Texas USA” [8]. Allen figured out “Reducing emissions required innovative policy approaches. These coupled scientific and policy innovations are described, and the result, substantially cleaner air for Houston, is documented. The lessons learned from the Houston air quality experience are relevant to cities with similar population and industrial profiles around the world”. The young scientist, Prof. Sun, gave a Research Article “Electrochemistry during efficient copper recovery from complex electronic waste using ammonia based solutions” [9]. This research proposes electrodeposition as the subsequent approach to effectively recover copper from the solutions after selective leaching of the electronic waste and focuses on recognizing the electrochemical features of copper recovery. Of course, there are some other papers which are good enough to be highlighted, e.g., those from Pontikes [10] and Lin [11]. But for the limited length of this editorial we suggest you read this Special Issue.

2 Bio- and medical are the new trends

Since our Editor-in-Chief, Prof. Jing-Kang Wang, is an expert in crystallization field, especially in medical area, we published many papers on “crystallization”. In early 2013, Prof. Ulrich discussed important research developments and arising challenges in the field of industrial crystallization with an emphasis on recent problems. The most relevant areas of research have been identified. These are the prediction of phase diagrams, the prediction of effects of impurities and additives, the design of fluid dynamics, the process control with process analytical technologies tools, the polymorph and solvate screening, the stabilization of non-stable phases, and the product design [12]. There are about 10 papers published in that issue (Issue 1, 2013).

The crystallization and phase determination are the major bottle-neck problems in crystallography. Prof. Huang together with his postdoctoral co-advisor Prof. Szostak reviewed the synthesis and strategy of selenium-derivatized nucleic acids (SeNA) for nucleic acid crystallography. They suggest that SeNA may not only provide the rational strategies to solve the phase determination problem, but also offer a potential strategy to explore crystallization solutions [13]. This review is one of the papers from the special topic on “nucleic acid-protein chemical and structural biology for novel drug discovery” [14]. The guest-editor, Prof. Lilley’s review is about “Ribozyme and the mechanisms that underlie RNA catalysis” [15]. The cover paper by Janez concluded that “DNA oligonucleotides containing four GGGGCC repeats exhibit folding into multiple G-quadruplex structures. Presence or absence of CC or TT residues

at 5'- or 3'-ends of $d[(G_4C_2)_3G_4]$ sequence and composition of presumed loop residues were shown to have a profound effect on folding. Furthermore, complex equilibrium between different structures adopted by $d[(G_4C_2)_3G_4]$ could be influenced by pH and concentration of added K^+ ions" [16].

On March 10, 2017, *Science* launched a Special Issue on Synthetic Yeast Genome. Prof. Yuan of Tianjin University is the corresponding author of two papers [17,18]. In the same year, Prof. Yuan as one of the guest-editors organized a Special Issue on "Collaborations of China with the world in Synbio" [19]. Here we would like to mention six Chinese groups from which you could get a common sense of the main research group on Synbio in China. They are Prof. Yang's group of Shanghai Institutes for Biological Sciences [20], Prof. Zhou's group of Jiangnan University [21], Prof. Xiao's group of Tianjin University [22], Prof. Su's group of Beijing University of Chemical Technology [23], Prof. Dai's group of Tsinghua University before 2018 (now of Shenzhen Institutes of Advanced Technology, Chinese Academy of Sciences [24]) and Prof. Yu's group of Zhejiang University [25].

3 Catalysis is always very important

The third highly cited paper of *FCSE* is about "Recent advances in selective acetylene hydrogenation using palladium containing catalysts" by Prof. Anderson of University of Aberdeen in 2015 [26]. And two other Reviews also on catalysis with more than 30 citations are "Mesoporous zeolites as efficient catalysts for oil refining and natural gas conversion" in 2013 [27] and "A review on *ex situ* catalytic fast pyrolysis of biomass" in 2014 [28].

"Catalysis plays a central role during almost all of the transformation processes, such as oil refining, coal processing and utilization, fuel cell, energy storage, hydrogen generation and storage, solar energy utilization and biomass conversion. Catalysis also plays a very important role in environmental protection such as greenhouse gas emission, water purification, CO_2 capturing and transformation." Thus, a Special Issue of *FCSE* on frontiers of catalysis chemistry and technology was organized by Profs. Liu and Li of Dalian Institute of Chemical Physics, CAS, China [29]. "These contributions covered a wide range of research topics focusing on novel process development and new catalyst and new methods for catalyst preparation, with applications to petro refinery, hydrotreating, olefins and/or PX production, biomass conversion, H_2O_2 production, NO reduction and CO_2 separation/capture. This reflects the multidisciplinary feature of catalysis science and technology".

The Review "Engineering operando methodology: Understanding catalysis in time and space" contributed by Prof. Bañares of Instituto de Catálisis y Petroleoquímica [30] and the Research Article "Copper nanoparticles/polyaniline-derived mesoporous carbon electrocatalysts for hydrazine oxidation" by Prof. Asefa of The State University of New Jersey in Issue 3, 2018 [31] are also worth reading.

4 Processing is on the way of intelligent and saving energy

Process systems engineering is not new but is on the way of intelligent and saving energy. *Engineering* organized a Special Issue on "Smart Process Manufacturing" in 2017. As the guest-editor, Prof. Qian said "The process industry, which mainly includes elementary raw material industries such as petroleum, chemical engineering, steel, nonferrous metal, and building materials ... is at a critical and historic moment of transformation, resulting in the development of accurate production operations, efficient and smart manufacturing processes, and system-optimized design with the integration of safety and environmental sustainability [32]." At the same time, he and his friend Prof. Gui published their research results in *FCSE* focusing on this area [33,34]. Based on the 20th Conference on Process Integration, Modelling and Optimization for Energy Saving and Pollution Reduction (PRES'17), in the last issue of *FCSE* in 2018, we will publish more than 15 papers coming from Czech, Germany, Italy, Hungary, France, Slovakia, Ukraine, Austria, and USA. These papers are mainly on sustainable energy utilization, integration and optimization.

Following the steady steps, *FCSE* is expected to become a leading, high impact, international scientific journal in the near future. In pursuing the goals of *FCSE* we need a robust partnership with authors, reviewers, governance, and staffs.

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