

Editorial



Flow chemistry has seen a significant uptake over the last 20 years, and this has led to an increase in its adoption across various industries and academic groups. Indeed, as an enabling technology, flow chemistry has the potential to change the way we tackle industrial processes, but also speed up discovery and academic research, with clear ripple effects on society globally. As any relatively new technology, flow chemistry has followed the typical hype cycle with a sensational boost of expectations around the beginning of the 21st century, followed by the necessary timeframe to reach the appropriate uptake; it is only in the last few years that we have achieved a step change. This is possibly due to the higher level of technology maturity, better understanding of how to deploy the technology, more availability of tools at lower cost – and I personally believe this is partially due to the understanding that flow chemistry needs to be part of a toolbox of technologies and its integration in scientific and operational plans provides great advantages if supported by a specific strategic outlook.

For this special issue, we wanted to capture some examples across the globe which provide a glimpse of how the technology is used, integrated with other tools, to innovate. Indeed, the evolution of flow chemistry coincides with the developments for how the technology is nowadays understood and being applied to solve problems and open opportunities.

Steve Ley (University of Cambridge, UK), **Samuel L. Bourne** and **Franz Amann** (CARBOGEN AMCIS) provide an overview of current trends and offer their view of the future of drug development and manufacturing, based on applications of flow chemistry (with examples of progress being made at Carbogen)

The topic of educating the next generation of students is reported by **Christophe Allemann** and **Roger Marti** (HEIA-FR), with flow chemistry seen as a growing and promising technology which can be deployed in research, development, and production.

Oliver Kappe and co-authors (University of Graz and the Research Center Pharmaceutical Engineering GmbH, Austria) introduce the very hot topic of smart manufacturing and digitalization, moving towards a data-rich approach enabled by flow chemistry and automation.

Sustainability and biocatalysis are so relevant for the future and **Francesca Paradisi and co-authors** (University of Bern) showcase how flow chemistry offers new possibilities to integrate biocatalytic steps within a chemical cascade, often without the need to redesign the whole pathway.

Andrew de Mello and co-authors (ETH Zürich and London South Bank University, UK) describe how microfluidics methods can be applied to the synthesis of nanomaterials for the generation of high-quality products with outstanding structural, electronic and optical properties – considering challenges with integration of additional functional components and the upscaling of such platforms for production of industrial-scale quantities of nanomaterials.

The history of flow chemistry at Eli Lilly is presented by **Martin D. Johnson and co-workers** (Eli Lilly, Indianapolis, USA), highlighting how the technology was initially used to speed up early phase material delivery in the development laboratories, and later to enable safe scale-up of hazardous chemistries to manufacturing plants.

Erik V. Van der Eycken, Upendra K. Sharma and co-workers (University of Leuven, Belgium) focus on miniaturized flow devices and approaches, highlighting the most relevant examples aimed to improve and intensify chemical processes as well as complex integrated microsystems, demonstrating the potential to become the ideal technology for the future.

Duncan L. Browne, Jamie A. Leitch (University College London, UK) and **Paul Richardson** (Pfizer Inc. San Diego, USA) describe how the frustrations of precipitation, fouling and blockages of liquid-based flow can be tackled by the emerging technique of mechanochemistry and reactive extrusion as a continuous process that can directly work on solid.

Enjoy the read!

Claudio

Dr. Claudio Battilocchio
Transformation Lead CPR, Digital and Automation Prototype
Syngenta Crop Protection AG

It is with great pleasure that the Editorial Board of CHIMIA thanks Dr. Claudio Battilocchio for his efforts in the planning and successful realisation of this wide-ranging issue on 'The Evolution of Flow Chemistry', presenting articles from an international authorship to demonstrate the progress this topic has made in the past years.