

Preface

Molecular recognition plays a critical role in numerous living systems. Protein-based receptors, nucleic acids, enzymes and antibodies are well-known examples of biological materials that have high molecular binding selectivity. Because of their well-defined molecular recognition properties, these biological macromolecules have been exploited in many technical applications to offer efficient purification for therapeutic products and to develop analytical methods for monitoring drugs, toxic chemicals in food and environmental pollutants. Although widely used, biological macromolecules are limited by their high production costs and low stability. This problem has stimulated the development of synthetic materials that can be designed to have tailor-made molecular selectivity. Molecular imprinting, a synthetic technique that uses molecular templates to create selective binding sites in cross-linked polymers, has become one of the most efficient methods for preparation of selective recognition materials. Molecularly imprinted polymers (MIPs) are robust, they can even be sterilized without losing their unique properties. MIPs can be produced in large quantities and can be re-used many times. These features make MIPs suitable in particular for a number of biochemical applications and recently the stability properties have attracted interest from the environmental sector since biomolecules are degraded in non-sterile environments while MIPs may be stable over extended periods of time.

The history of molecular imprinting can be dated back to the 1930' although it is generally accepted that the modern era of the technique started some forty years ago. Over the past twenty years, the interest in this synthetic technique and its applications has increased exponentially, as reflected from the number of annual publications until 2014 (Fig. 1). Initially most focus was on making molecular imprints of small molecules but during the last decade more and more activities have been observed concerning MIPs against macromolecules and even particulate matter such as cells. During this development a trend towards use of less apolar solvents have been seen since e.g. proteins tend to precipitate when exposed to hydrophobic solvents

The development in literature gives interesting observations concerning the areas of applications. Initially, high resolving separations were the focus, later on MIPs

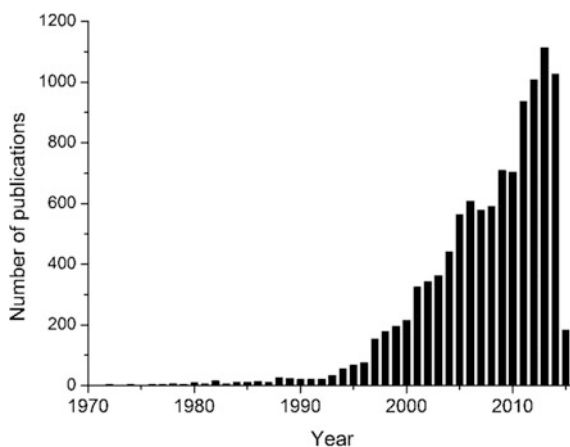


Fig. 1 Number of publications related to the topic of molecular imprinting. The data include research papers, conference abstracts, book chapters and review articles. Source www.mipdatabase.com (courtesy Dr. Michael J. Whitcombe)

were used for solid phase extraction as a pre-step before analysis and more recently nano-MIPs are studied as tools in biological systems.

In the past, application of MIPs has been limited to organic solvent-based systems due to the intrinsic hydrophobicity of the synthesized materials. The recent development in molecular imprinting technique started to bring in many novel MIP materials that can be applied directly under aqueous conditions. For the first time, synthetic MIPs start to act as “antibody mimics” to enable direct analysis and treatment of biomedical/biochemical samples under aqueous conditions. This important step has been realized thanks to a number of breakthroughs that are reviewed in the present volume: new synthetic chemistry (Chaps. 313 and 318) and analytical characterization (Chap. 316), computational design (Chap. 314). After introducing the fundamental aspects in material synthesis, we provide expert reviews on the use of MIPs for treating aqueous samples from an academic (Chap. 319) and industry angle (Chap. 317). MIPs for catalysis (Chap. 312), in environmental biotechnology (Chap. 311) and for biotransformation (Chap. 315) are also reviewed with the intention to provide further updated progresses.

We hope that this volume can provide a useful background for interested researchers and can inspire future development of MIPs for biotechnology and biomedical applications. We thank all the authors for their excellent contributions.

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