Handbook of Phase Transfer Catalysis

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Handbook of Phase Transfer Catalysis

Edited by

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Preface

Even though phase transfer catalysis was described as a 'mature' discipline with 'standard' methods [1], we have witnessed over the past twelve years a continuous flow of new scientific papers and patents dealing with phase transfer topics and new applications at an almost constant annual rate of 300 to 320 articles and 70 to 80 new patents per year. At the beginning of March 1997, over 6200 references could be retrieved from the chemical abstracts under the term 'Phase Transfer Catalysis'.

Browsing through recent references, one can conclude that PTC has evolved from a mere, though significant, improvement of aliphatic substitution reactions into previously unforeseen domains. Phase transfer is presently a basic tool in polymer chemistry, heterocyclic chemistry, organometallic synthesis and pharmaceutical and agrochemical manufacture [2]. A major recent evolution is the introduction of PTC into chemistry related to the environment. Phase transfer methods are currently being applied to the revision of production processes, for example by elimination of solvents [3]. Another new application is the decomposition of poisonous effluents, such as PCBs at low PPM levels [4]. The development of novel highly sensitive analytical methods based on PTC is now practiced for a vast spectrum of analytical applications. For instance, PTC methods are used in the medical laboratory in the determination of estrogen in human serum [5], in the forensic laboratory for detection of post explosion residues [6] and in the geochemical laboratory for assay of organic matter in Arctic surface sediments [7].

Other new frontiers are developing rapidly. For example, supercritical fluids [8] such as carbon dioxide are now being used as unique PTC solvents, ultrasonic and microwave equipment are being introduced into the PTC arena and highly refined biomaterials such as carbohydrates or proteins are being processed and synthesized. Quaternary ammonium salts are used to stabilize colloidal metallic nano-particles [9]. Species like sodium metal [10], sodium hydride [11] or potassium tert-butoxide [12] are now being extracted by phase transfer agents and catalytic effects are clearly observed in highly polar solvents such as DMF or DMSO in the presence of PT catalysts. The classical direction of the phase transfer extraction process has been reverted with the introduction of inverse PTC – catalysis for transport of reactive species from organic phase into water. New structures phase transfer catalysts are being developed including chiral, temperature stable and multifunctional catalysts. These are all presently available and are effective tools in the hands of the synthetic or process chemist. The important issue of catalyst

recovery and recycle has now been addressed with new methods recently introduced [13].

Numerous patents based on PTC technology are being issued to major multinational chemical companies such as General Electric, DuPont, Dow, Bayer, Zeneca, Ciba-Geigy, Merck, Eli Lilly and Sumitomo. The major driving force for industrial application of PTC was attributed to increasing reaction rate (reduction of cycle time) and replacing, reducing or eliminating solvents [14].

This volume aspires to address these and other new developments in the area of phase transfer catalysis, along with the recounting of some fundamental concepts, without repeating the large amount of material that has been discussed in depth in the previous excellent books in the field. As for future trends, we believe that essentially any heterogeneous reaction or separation system, either in the micro-, or the macroscale may call for the application of phase transfer concepts. We believe that numerous new applications in synthesis, separation and assay of new materials and active molecules are just around the corner.

We wish to extend our gratitude to our highly competent and authoritative writers and to the professional team at Chapman & Hall who made this book possible.

Yoel Sasson and Ronny Neumann
Jerusalem, March 1997

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