Special Issue: Water Soluble Polymers

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Abstract:

This Special Issue (SI) of Processes on water soluble polymers (WSP), and the associated Special Issue reprint, contain papers that deal with this extremely popular area of scientific investigation in polymer science and engineering, both in academic and industrial environments.[...]

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Editorial

Special Issue: Water Soluble Polymers

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This Special Issue (SI) of *Processes* on water soluble polymers (WSP), and the associated Special Issue reprint, contain papers that deal with this extremely popular area of scientific investigation in polymer science and engineering, both in academic and industrial environments. Research and technology on WSP are of current interest not only due to the largely unstudied polymerization kinetics of WSP, but also due to the plethora of technologically innovative applications. Synthetic water soluble copolymers (and terpolymers) can modify and improve aqueous solution properties in relation to gelation, thickening, emulsification, stabilization and rheology. Therefore, these polymers find many uses as flocculants and coagulants (for waste water treatment), film-formers, binders, lubricants and coatings, and in enhanced oil recovery (EOR), dewatering, oil-field product and mineral processing, pulp and paper industry (improving paper's printing quality), water retention and treatment, and also as biomedical, pharmaceutical and high value cosmetic products.

Hence, we have invited papers on a wide variety of topics, starting from polymerization kinetics (emphasis on multicomponent systems), clarification of factor effects (for example, ionic strength, pH, monomer concentration, and how they influence important chain characteristics and properties), mathematical modelling and parameter estimation, and process design, and ending with applications (i.e., using the well characterized polymer molecules to deliver specific desirable properties for specific applications (hydrogels, cosmetics, drug release, flocculation, nanotechnology, enhanced oil recovery, polymer flooding, absorbents, crosslinking, and many others)). We have been particularly interested in receiving manuscripts that integrate experimental and theoretical/computational studies, as well as contributions from industry. We have thus invited not only academics but also researchers and practitioners from related industry to submit manuscripts for this important Special Issue (SI) of *Processes*.

This SI has already published 12 very high quality papers. The author groups clearly span the globe and represent currently active researchers in the WSP area. The topics are not only current (cutting-edge research) but also of great academic (fundamental phase) and industrial (applied phase) interest. The papers are cited below, with brief comments for each paper concerning the main topic and contributions of the paper. The careful reader will observe the evolution of several common threads (traversing the wide spectrum of polymerization kinetics and modelling all the way to properties of nano-composites and hydrogels) in the themes of these 12 papers and the (water soluble) materials they describe.

(1) Marić, M.; et al. Poly(methacrylic acid-*ran*-2-vinylpyridine) Statistical Copolymer and Derived Dual pH-Temperature Responsive Block Copolymers by Nitroxide-Mediated Polymerization. [1]

The very first submitted and accepted paper of the Special Issue on water soluble polymers deals with nitroxide-mediated polymerization using NHS-BlocBuilder. The main contributions (in fundamental polymer science and chemistry) are twofold: (a) To produce copolymers with tunable water solubility; and (b) To synthesize block copolymers with pH-temperature responsive properties.

(2) Scott, A.; et al. AMPS/AAm/AAc Terpolymerization: Experimental Verification of the EVM Framework for Ternary Reactivity Ratio Estimation. [2]

The paper describes terpolymerization kinetics of an acrylamide/acrylic acid terpolymer that finds uses in enhanced oil recovery. The main contribution is an experimental demonstration of deriving optimal feed compositions for the design of experiments that lead to optimal reactivity ratio parameter estimation under the EVM framework, which in turn lead to reliable model predictions for terpolymer composition over the full conversion range.

(3) Tsai, B.; et al. Poly(Poly(Ethylene Glycol) Methyl Ether Methacrylate) Grafted Chitosan for Dye Removal from Water. [3]

This paper's subject is chitosan grafting to produce adsorbing materials for textile dye removal from water (water pollution and textile material production). The adsorbing materials are produced via nitroxide-mediated polymerization 'grafting to' approach. The main contribution, after detailed grafting polymerization chemistry and adsorption studies, is that grafted chitosan is much more effective (by about 30%) than its parent chitosan.

(4) Rintoul, I. Kinetic control of aqueous polymerization using radicals generated in different spin states. [4]

This paper provides an analysis of experimental conditions required to develop (and potentially exploit) magnetic field (MF) effects in the free radical polymerization of water-soluble polymers. Electron spin states (configuration), MF intensity, and solution viscosity are varied and evaluated for the solution polymerization of acrylamide. It is found that MF effects are significant in photoinitiated polymerizations, specifically at low MF intensities and in viscous reaction media. MF effects are absent in thermally initiated polymerizations (regardless of MF intensity).

(5) Wu, A.; et al. Simultaneous Monitoring of the Effects of Multiple Ionic Strengths on Properties of Copolymeric Polyelectrolytes during Their Synthesis. [5]

The paper describes an automated online monitoring system with multiple light scattering and viscosity detectors (ACOMP). Results demonstrate the capabilities of ACOMP with the acrylamide/styrene sulfonate copolymerization system for a series of ionic strength levels.

(6) Hughes, A.; et al. Biodegradable and Biocompatible PDLLA-PEG1k-PDLLA Diacrylate Macromers: Synthesis, Characterisation and Preparation of Soluble Hyperbranched Polymers and Crosslinked Hydrogels. [6]

This paper describes many aspects behind the chemistry and the art of preparing soluble hyperbranched polymers and cross-linked hydrogels. Starting from the ring opening polymerization of D,L-lactide, the target is biodegradable hydrogels with tailored swelling properties for potential applications in regenerative medicine.

(7) Emaldi, I.; et al. Kinetics of the Aqueous-Phase Copolymerization of MAA and PEGMA Macromonomer: Influence of Monomer Concentration and Side Chain Length of PEGMA. [7]

In-situ NMR is employed to monitor the copolymerization of fully ionized methacrylic acid and PEGMA macromonomer, investigating the effects of monomer concentration and side chain length of PEGMA. Different trends in estimated reactivity ratio values are demonstrated and explained.

(8) Achilias, D.; et al. Polymerization Kinetics of Poly(2-Hydroxyethyl Methacrylate) Hydrogels and Nanocomposite Materials. [8]

This paper takes us into the world of bio(nano)materials and potential applications in tissue engineering and contact lenses, by studying poly(HEMA)-based hydrogels. There are two main contributions in the paper: (a) The development of a detailed and improved model for HEMA polymerization kinetics over the full conversion range; and (b) The effects of nano-additives on the rate of (in situ) polymerization (nano-silica vs. nano-montmorillonite) with possible explanations of the observed behaviour.

(9) Fischer, E.; et al. Aqueous Free-Radical Polymerization of Non-Ionized and Fully Ionized Methacrylic Acid. [9]

The topic of this paper is the free radical polymerization of non-ionized and fully ionized methacrylic acid, in an effort to shed additional light on the peculiar polymerization kinetic behavior of carboxylic acids in aqueous media. The strength of the paper is the clarity of the model development stages and the suggestion of a novel propagation rate expression that takes into account the effect of electrostatic interactions (fully ionized case).

(10) Han, W.; et al. Applications of Water-Soluble Polymers in Turbulent Drag Reduction. [10]

Turbulent drag reduction is a complex topic which has been reviewed from several different angles (ranging from rheology/fluid mechanics to polymer concentrations used all the way to mathematical models involved). Hence, what would yet another review paper on the topic possibly accomplish? The authors of the current paper critically review 117 recent references and look at turbulent drag reduction from the angle of the types of water soluble polymers and copolymers employed, both synthetic (see Table 1) and natural (see Table 2), along with potential applications.

(11) Steinmacher, F.; et al. Design of Cross-Linked Starch Nanocapsules for Enzyme-Triggered Release of Hydrophilic Compounds. [11]

The paper describes the synthesis of cross-linked (X-linked) starch (aqueous-core) nanocapsules (NCs) in inverse mini-emulsion and shows experimental data on the influence of X-linker level on several product variables, including morphology. The main contribution of the paper is the design of both a permeable and impermeable NC shell depending on X-linker level. Impermeable shells are further investigated with respect to release studies.

(12) Pérez-Salinas, P.; et al. Comparison of Polymer Networks Synthesized by Conventional Free Radical and RAFT Copolymerization Processes in Supercritical Carbon Dioxide. [12]

Although this paper's main topic is RAFT vs. regular free radical copolymerization hydrogels in supercritical CO_2, the approach for comparing and evaluating polymer networks is general and hence applicable to other types of (co)polymerization. Based on a rich set of experimental results, the main contributions of the paper are twofold: (a) A quantitative criterion is suggested for assessing the degree of heterogeneity (homogeneity) of a polymer network; and (b) The paper concludes with additional information on antibiotic loading, adsorption and release studies for the investigated hydrogels.

One can locate and read these papers via the following link:

http://www.mdpi.com/journal/processes/special_issues/soluble_polymers

In order to complement the above 12 excellent contributions, the deadline for this SI has been extended to 30 September 2017. In addition, *Processes* is planning to produce a Special Issue Reprint (SIR) for this successful SI. The SIR will become available online at Amazon after all the papers have been reviewed and published.

We are looking forward to your contribution before 30 September 2017.

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