

NONLINEAR CHEMICAL DYNAMICS IN SYNTHETIC POLYMER SYSTEMS

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Abstract. The application of the methods of nonlinear chemical dynamics to synthetic polymer systems is considered. We review the differences between polymers and inorganic systems that have been the subject of nonlinear dynamics. We consider two methods for approaching the problem – coupling polymers to other nonlinear systems and using inherent nonlinear behavior of polymers. We specifically focus on frontal polymerization.

Keywords: autocatalysis, feedback, frontal polymerization

1. Introduction

What is to be gained from applying the methods and concepts of nonlinear dynamics to polymer systems? Are there things that nonlinear dynamicists can learn, or that polymer scientists can make, that would not be possible without bringing these two apparently disparate fields into contact? First we briefly review some distinguishing characteristics of polymers. Next, we suggest three challenges that present themselves. We then examine sources of feedback in polymeric systems. Next, we propose several approaches to develop nonlinear dynamics with polymers. Finally, we give some examples of results that suggest that these approaches are likely to bear fruit.

We do not have the space to review polymers but refer the reader to several texts [1–3]. What we seek to provide here is a brief overview of the most important differences between polymeric systems and small molecule ones, review sources of feedback, approaches to nonlinear dynamics with polymers, including some specific examples.

We will not deal with biological systems, which certainly are polymeric systems. Biological systems are nonlinear dynamical systems but they are complex enough and so important that they warrant separate treatment. We refer the reader to Goldbeter's book [4] for an introduction to the topic.

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Nonlinear Dynamics In Polymer Science Polynon 99

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Nonlinear Dynamics with Polymers John A. Pojman, Qui Tran-Cong-Miyata, 2011-03-16 Closing a gap in the literature this is the first comprehensive handbook on this modern and important polymer topic Edited by highly experienced and top scientists in the field this ready reference covers all aspects including material science biopolymers gels phase separating systems frontal polymerization and much more The introductory chapter offers the perfect starting point for the non expert

Nonlinear Dynamics in Polymeric Systems John Anthony Pojman, Qui Tran-Cong-Miyata, 2004 This book discusses nonlinear dynamics in polymeric systems with a special emphasis on systems of potential utility including gels fronts phase separation interfacial phenomena and oscillating reactions

Index of Conference Proceedings British Library. Document Supply Centre, 2001

Deutsche Nationalbibliographie und Bibliographie der im Ausland erschienenen deutschsprachigen Veröffentlichungen, 2001

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Polynomial Models Andrzej Janczak, 2004-11-18 This monograph systematically presents the existing identification methods of nonlinear systems using the block oriented approach It surveys various known approaches to the identification of Wiener and Hammerstein systems which are applicable to both neural network and polynomial models The book gives a comparative study of their gradient approximation accuracy computational complexity and convergence rates and furthermore presents some new and original methods concerning the model parameter adjusting with gradient based techniques Identification of Nonlinear Systems Using Neural Networks and Polynomial Models is useful for researchers engineers and graduate students in nonlinear systems and neural network theory

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Applied Mechanics Reviews ,1977 International Aerospace Abstracts ,1999 **Computational Multiscale Modeling of Fluids and Solids** Martin Oliver Steinhauser,2016-11-29 The idea of the book is to provide a comprehensive overview of computational physics methods and techniques that are used for materials modeling on different length and time scales Each chapter first provides an overview of the basic physical principles which are the basis for the numerical and mathematical modeling on the respective length scale The book includes the micro scale the meso scale and the macro scale and the chapters follow this classification The book explains in detail many tricks of the trade of some of the most important methods and techniques that are used to simulate materials on the perspective levels of spatial and temporal resolution Case studies are included to further illustrate some methods or theoretical considerations Example applications for all techniques are provided some of which are from the author s own contributions to some of the research areas The second edition has been expanded by new sections in computational models on meso macroscopic scales for ocean and atmosphere dynamics Numerous applications in environmental physics and geophysics had been added

Nuclear Science Abstracts ,1973 **Soviet Aeronautics and**

Astronautics ,1985 **Polymer Reactor Engineering** C. McGreavy,2012-12-06 Approximately half of the world production of the petrochemical industry more than 100 million tonnes is in the form of polymers yet it would probably surprise most people to learn how much their lifestyle depends on polymers ranging as they do from detergents kitchenware and electrical appliances to furnishings and a myriad other domestic goods Still less are they likely to be aware of the extensive part they play in engineering applications for mechanical machine components and advanced high performance aircraft This versatility derives from the fact that polymeric materials are made up of a range of molecules of varying length whose properties are related to molecular structure and the proportions of the chains in the mixture For example polypropylene is a commodity polymer which is produced in hundreds of different grades to meet specific market requirements This depends on the catalyst as well as the operating conditions and reactor design A major area for growth is in substituting polymers for conventional materials such as ceramics and metals Not only can they match these materials in terms of mechanical strength and robustness but they have very good resistance to chemical attack Polyamides for example are widely used for car bumpers and new polymers are being developed for engine manifolds and covers In 1993 there is typically 100 kg of various polymers used in cars and this is continually increasing giving a net weight reduction and hence better fuel economy **Mathematical Reviews** ,2005 **Applied Science & Technology Index** ,1996

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