# Well-Architectured Fluoropolymers: Synthesis, Properties, and Applications

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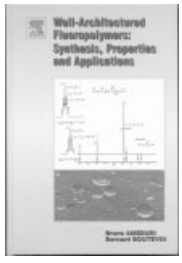
## Well-Architectured Fluoropolymers: Synthesis, Properties, and Applications



By *Bruno Ameduri* and *Bernard Boutevin*, Elsevier, 2004, hardcover, 480 pages, 189 €, ISBN: 0-08-044388-5

Since their serendipitous discovery in the late thirties, research into the field of fluoropolymers has grown dramatically due in part to their unique properties and applications. Their thermal stability and chemical inertness has made them attractive materials for the aerospace and biomedical fields, in addition to the microelectronic field for their inherent electrical and low optical properties. And these are just a few of the numerous fields to which these specialty materials have made in-roads. A wealth of literature has been put forth of late dealing with the design of fluorinated macromolecules in order to optimize these intrinsic properties for the development of high performance materials. Dendrimer, star polymers, and graft and multi-block copolymers represent the bulk of novel architectures being investigated in this area, with controlled radical polymerisation techniques taking a prominent role in their synthesis. A text reviewing these recent developments which incorporates advanced synthesis techniques as well as material properties and applications would prove invaluable for any researcher, whether in academia or industry, and the authors have accomplished just that.

They have compiled a volume ranging from the basics of fluorinated precursor and oligomer synthesis to various fluorinated copolymer architectures. Each of the five chapters is subdivided into detailed synthesis schemes, conditions, and results from literally hundreds of references per chapter, as well as polymer properties and industrial applications making it an ideal teaching aide for any fluoropolymer chemist. The first chapter details the synthesis and study of telomers generated from fluorinated alkene monomers. The chapter begins with basic telomer initiation and mechanisms before delving into some of the more common fluorinated alkenes used in telomer synthesis. The chapter then turns to telogen and monomer reactivity as well as a brief review of iodine transfer polymerisation before ending with the current applications of fluorinated telomers. The next chapter represents a thorough review of the various synthesis methods for creating fluorinated telechelic precursors. The precursors are separated into those which yield polymers with fluorinated backbones and those with fluorinated moieties, for industrial and non-industrial products. From here, the authors begin to examine the fluoropolymers generated from these telechelics. Although predominantly condensation polymerisation mechanisms, discussion of atom transfer radical polymerisation and other controlled radical techniques is depicted using diiodo- and dibromoperfluoroalkanes as initiators.

The remainder of the book deals with fluoropolymer synthesis from fluorinated monomers rather than generating telomeric or oligomeric precursors. The third chapter investigates the copolymerisation of fluorinated monomers with each other and non-fluorinated monomers. Beginning with a discussion of monomer reactivity, a table of the Q-e values for several fluorinated monomers, and copolymerisation basics, fluorinated copolymer synthesis and properties are given for several fluoromonomers with tetrafluoroethylene and vinylidene fluoride being the predominant monomers. After reviewing various alternating fluorinate copolymer systems, the fourth chapter discusses the research into di-, tri-, and multi block fluoropolymer synthesis. This also represents the first full introduction and discussion of controlled radical polymerisation techniques towards fluoropolymer synthesis. While a very brief background on controlled radical systems is given and the emphasis is on atom transfer radical polymerisation, the authors also depict the work dealing with reversible addition-fragmentation chain transfer, nitroxide mediated, and photoiniferter polymerisation methods. In addition, they also discuss non-radical polymerisation techniques such as ionic, ring-opening, metathesis, and group-transfer polymerisation. The chapter is rounded out with a discussion of the properties and applications of these particular fluoropolymer multiblocks and some differences with alternating copolymer systems.

The final chapter of this text deals with the synthesis and properties of fluorinated graft copolymer materials. The authors focus on two particular methods, the "grafting from" and "grafting to" polymer chain methods. Various initiation systems and polymeric backbones are discussed, in addition to the generation of fluoropolymer grafts and grafts on fluoropolymers with details of several industrial applications of these graft copolymer materials. While a rather limited discussion of other methods are given, the methods detailing the use of fluorinated macromonomers and polymerisation from macrotelogens revisits similar examples of the precursors and oligomers from the first two chapters during the macromonomer and macrotelogen reviews. This effectively ties together the relatively small chain synthesis and more advanced macromolecular designs, making for an exquisitely written and thorough text on current fluoropolymer research.

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