A Catalytic Approach for Cationic Living Polymerization: Sc(OTf)₃-Catalyzed Ring-Opening Polymerization of Lactones

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Received September 15, 1999
Revised Manuscript Received January 21, 2000

Aliphatic polyesters with a narrow molecular weight distribution (MWD) are of great interest especially for medical applications. Living ring-opening polymerization of lactones has been reported for that purpose mostly in an anionic or coordinated anionic fashion, whereas there have been rarely found successful cationic examples in the literature. Even the reported cationic living polymerization of lactones is problematic for two reasons: (i) initiators are extremely air- and moisture-sensitive; (ii) each molecule of the initiator produces, at most, only one molecule of polymer (Scheme 1a), and it is stoichiometric polymerization in the sense of the number of molecules. We describe herein a practical catalytic approach for cationic living polymerization of lactones using scandium trifluoromethanesulfonate, Sc(OTf)₃, as a catalyst commercially available, in which one reactive Sc(OTf)₃ molecule catalytically produces a large number of polymer molecules (Scheme 1b) and also in which contamination of protic compounds such as H₂O and ROH does not suppress the catalytic activity of Sc(OTf)₃ for cationic polymerization (eq 1).

Scheme 1

(a) Living polymerization

(b) Catalytic system of living polymerization

O : Reactive initiator or catalyst  ● : Monomer  A : Inert additive

10.1021/ma991580r CCC: $19.00 © 2000 American Chemical Society
Published on Web 02/17/2000