# 学术论文的写作

试用稿

## ● Title

### Title 通常为名词性词组、短语。一般可分为以下几类:

#### 一．以研究内容命名

SYSTHESIS OF 2-O-PROTECTED GLYCEROL DERIVATIVES

Ring-Opening Polymerization of Cyclic Carbonates by Alcohol-Acid Catalyst

#### 二．以研究对象命名

A New, Crystalline High Melting Bis(hydroxymethyl)polycarbonate and Its Acetone Ketal for Biomaterial Applications

Microdomain structure in polylactide-block-poly(ethylene oxide) copolymer films

#### 三．以研究内容、研究对象综合命名

Poly(ethylene carbonate)s, part I: Syntheses and structural effects in biodegradation

Hydrolytic degradation of tyrosine-derived polycarbonates, a class of new biomaterials. Part I: Study of model compounds

## ● Abstract

### Abstract 通常由以下几方面组成：<其前后顺序可相互交叉>

#### 一．简要介绍研究背景 <多数文章的 Abstract 中已将此部分省略>

Poly(N-isopropylacrylamide) (PNIPA) is a thermally sensitive polymeric material. PNIPA hydrogel has been widely used in many fields.

#### 二．叙述做了哪方面的研究

根据具体内容，通常用一般过去时、被动态:
Poly(1,3-trimethylene carbonate) (PTMC) **was synthesized** by diethylzinc-catalyzed ring-opening polymerization of 1,3-trimethylene carbonate. The polymer **was characterized by measurement**

of its thermal and mechanical properties, permeability, and susceptibility to hydrolytic chain scission in vitro and in vivo.

…In addition to the initiator, **reaction time, temperature, and monomer/initiator (M/I) ratio were varied.**

Reactivities of six-membered cyclic carbonates **were studied** and a carbonate-modified acrylic polymer wa**s synthesized**, which **was expected to** show good water resistance.

**The effect of** polymer chemistry **on** adhesion, proliferation, and morphology of human articular cartilage (HAC) **was evaluated**.

**In order to study** the degradation mechanism of these polycarbonates **in more detail, a series of** small model compounds **were designed** that mimic the repeat unit of the polymer.

Tyrosine-PEG derived poly(ether carbonate)s **were prepared** by condensation copolymerization with phosgene. …Chemical structure and purity **were confirmed by NMR and FTIR spectral analysis.**

The mechanism of decarboxylation **was discussed from the viewpoint of** …

**Based on** the symmetrical structure of these products, a mechanism for chain initiation and …**was proposed**.

根据具体内容，有时要用一般现在时或其它：
The novel convergent growth approach to topological macromolecules based on dendritic fragment **is described**.

**In present paper** plasma methods **are discussed with respect to** other techniques which also induce micropatterned cell growth.

也有少部分用主动态：
**Our study focused on the role of** poly(ethylene glycol) (PEG) in actively regulating the biological responsiveness of protein-adsorbed biomaterials. **To this end, we designed** PEG-variant biomaterials from a family of tyrosine/PEG-derived polycarbonate to present surfaces ranging from low to intermediate levels of PEG concentration, … **We analyzed the effect of** PEG concentration **on** the amount, conformation and bioactivity…

We **have investigated** the ability of these dendrimers to function as an effective delivery system…

**This paper describes** the synthesis and evaluation of biodegradable derivatives of poly-L-glutamic acid as suitable vectors for gene therapy.

## 三．阐明得到了哪些主要结论

时态根据具体情况而定：

**These results strongly suggest** that the cyclic carbonates are activated by trifluoroacetic acid.

$Et_2Zn$/ethylene glycol **was found to be** exceptionally effective as a catalyst for this copolymerization.

**Surprisingly,** the biodegradation of PECs having Mws<100000 is strongly suppressed.

The concentrations of the monomers formed in the depolymerizations **well agreed with** the equilibrium monomer concentrations in the anionic ring-opening polymerizations.

**The highest** poly(TMC) molecular weight **was obtained by** conducing the polymerization at 55 ℃

**Increasing** the water content **resulted in enhanced** polymerization rates and **decreased** molecular weights.

The dimension and surface area of the devices **influenced** the initial degradation rate, **but did not significantly affect** the overall rate of degradation.

A carbonate-modified acrylic polymer **showed** excellent hydrolysis resistance…

The dendritic polymer **seems to be a promising** carrier for the controlled release of antitumor drugs.

The properties of these polymers **depend upon** the ratio of monomers and...

**Our results demonstrate** that low levels of PEG can regulate not only on the extent but also the conformation and specific bioactivity of adsorbed model protein…**Our studies also indicated** that the rate of cell migration **was inversely correlated with** PEG concentration over a narrow range of PEG concentration.

**Results obtained** from the use of these model compounds **suggested** that the backbone carbonate bond is hydrolyzed at a faster rate than the pendent chain ester bond.

**The results from this study can be used to explain** the degradation behavior of the corresponding polycarbonates as well as their degradation mechanisms.

# ● Introduction

时态根据具体内容而定。

**Introduction 通常由以下几方面组成：**

**一. 介绍研究背景 、 研究意义**

Spiro orthocarbonates (SOCs) undergo double ring-opening polymerization with an expansion in volume [1-4]. **This unique property attracted the interest of polymer chemists** [5,6].

Since the early 1960s, several synthetic, degradable polymer systems have been used as medical implant materials. **Some widely investigated examples include** poly(lactic acid) [1,2], …, …, and polyorthoesters [6,7].

Wichterle ＜姓＞ and Lim **developed the first** synthetic polymeric hydrogels based on hydroxyethyl methacrylate, for use as biomaterials [2]. **Since then, there has been continuing interest in the development of** novel types of hydrogel materials for biomedical application.

Development of biodegradable plastics **is being extensively promoted as one of the solutions to** plastic waste disposal. Aliphatic polyesters **are currently considered the most promising materials** for the production of biodegradable plastics.

**In recent years more and more** technical fields have begun to use low-temperature plasmas. **Important new applications have been found** in biomedical techniques….**Good examples for novel techniques very near application and already applied** are plasmas sterilization….**This is important not only for** polymeric biomaterials, **but also for** other materials. **A lot of publications already exist in this field.**

**It is well known that** poly(N-isopropylacrylamide) (PNIPA) gel is thermally sensitive in its response to external temperature changes. … PNIPA gel **has attracted great interest and been extensively studied in the recent 20 years due to its applications in many fields**, such as artificial muscle [2], on-off switches [3], and immobilization of enzymes [4], etc.

**Very recently,** Kricheldorf et al. **have reported** the synthesis of high molecular weight polycarbonate…, although the detailed mechanism is not clear. [5]

The anionic living polymerization technique yielding polymers with narrow molecular weight distributions **has been widely adopted** as a method to prepare homo- and especially block copolymers[1)].

Gene therapy is a relatively new technique in the field of biotechnology and medicine **that is attracting a lot of attention.**

The free radical polymerizations of cyclic ketene acetals **have recently evoked a lot of interest**.

The use of enzyme catalysis in organic media for polymer-forming reactions **is gaining increasing attention**. **The hallmark of** enzymes is their ability to achieve high enantio- and regioselectivity for various chemical transformations.[1] **Furthermore,** enzymes represent a family of "environmentally friendly" catalysts. **Advantages of using** enzymes in organic as opposed to aqueous media **are as follows:** (i) increased enzyme thermal stability, (ii) solubility of a wide range of substrate types in the reaction media, (iii) no requirement for pH adjustment as the reaction proceeds, and (iv) readily recyclable. [2,3]

**Whereas** aromatic polycarbonates **have achieved wide application and great importance** as polymer materials since 1954,[1] aliphatic polycarbonates **have been less interesting due to** their poor thermal stability and easy hydrolysis. **During the past decade, increasing attention has been paid to** aliphatic polycarbonates for their potential in the medical field and in the environmental control of plastics.[2-8]

**Stimulated by the need for** bioresorbable medical materials with a wide range of physical properties and degradation rates, **there has been considerable interest in exploring** aliphatic polycarbonate prepared by ring-opening polymerization of cyclic carbonate monomers.[1-7] **Efforts have thus far focused on** polymerizations of five- and six-membered ring aliphatic cyclic carbonates.

## 二. 阐述目前该领域的研究现状、存在问题、待解决的问题

Ring-opening polymerization of six-membered cyclic carbonates **have been studied in detail** by Kricheldorf et al. [4,5] and Sarell et al. [6-8] after the first work on their reactivity by Searles [9]. **In recent years there has been renewal of interest in** polymerization of six-membered cyclic carbonate **since Endo et al. demonstrated** that TMC showed volume expansion during polymerization [10].

**Although** the cationic ring-opening polymerization of SOCs **has been investigated extensively, only** a low molecular weight (MW) polymer was obtained and the MW cannot be controlled.

**Although** the utility of these materials as sutures and in a number of drug delivery applications **is well established, some material's needs cannot be satisfied by their use. For example,** all polyesters release acidic degradation products [6-8], **limiting their utility to applications** where acidity at the implant site is not a concern. The above polyesters **also tend to be** relatively rigid, inflexible materials [9], **This can be a definite disadvantage when** mechanical compliance with soft tissue or blood vessels **is required**. **Finally, none of the above polyesters provides** a chemically reactive pendent chain for the easy attachment of drugs, crosslinkers and biologically active moieties.

**The investigation** of poly(ether carbonate)s **started in the 1960s.** …However, copolymers of

diphenols and PEG **have so far not been studied** as medical implant materials.

**A number of studies have illustrated** the strong effects of PEG on the activity and conformation of proteins in solution [15-17]. **However, the role** of lower-range PEG interactions that may allow protein adsorption and cell adhesion on biomaterial **has been largely overlooked**. **Thus,** the biological "regulatory" behavior of PEG-bearing surfaces **is not clearly understood**, **especially** at low and intermediate levels of PEG surface concentration.

**Thus, there is a need to** design biomaterial surfaces that are systematically responsive to protein adsorption in a precise, tissue-specific manner.

**Unfortunately, the current** treatment options for articular cartilage repair **suffer from certain limitations** [1,2]. The clinical **need for improved methods** for articular repair **have motivated many researchers to explore** tissue engineering approaches…

Practical application to environmental-friendly materials **has been restricted by** the low melting point, **and more efforts have been, therefore, directed to overcome** the thermal unstability.

**Although many reports have been published on** the polymer blends of PCL [3-9], **there are only a few on** the study of biodegradation.

**In view of** the widespread use of silicones (polysiloxanes),[1] **it is rather surprising that** the **literature documents have seldom reported systematic approaches** to the synthesis of structurally defined oligosiloxanes.

**Although** synthetic poly(amino acid) **have been widely investigated, very few practical applications have been identified** for these polymers.

## 三. 指出本文的研究内容、目的及其独到之处

**The objective of the present study was to synthesize** well –defined ABA copolymers…**and to investigate** feasibility of preparing phase-separated structures in blends…**In this work we attempt to** minimize transesterification reactions.

Our model PEG-variant surface were based on a family of tyrosine-derived biomaterials, **which have been well characterized** both in vitro and in vivo, **and have shown great promise** for use in tissue engineering applications.

This study reports **for the first time** <慎用， 可加： as far as we know， to the best of our knowledge> that PEG, when present on a biomaterial surface in small, controlled amount, can modify, in a systematic manner, the attachment of proteins and in turn, the adhesion and migration of cells.

**In this paper, we present data on …**

**Recently, we found that**…. **In this paper** mechanistic aspects of the polymerization as well as polymerization conditions suppressing decarboxylation **are discussed in detail**.

**The present work was aimed at studying …**

**Here we report** the introduction of PEG blocks into the backbone of polycarbonates to form poly(ether carbonate)s. … **The effects** of length of the PEG block on the properties of the resulting copolymers **were investigated**. **Correlations were established** between the copolymer composition and its material properties such as glass transition temperature, mechanical strength, …and drug release. **In addition, preliminary data** on the in vitro interaction of cells with these polymers **were obtained. In a separate publication,** the inverse temperature transitions observed for this class of polymers **are described** [33].

# ● Experimental

通常用一般过去时、被动态。

## 根据实验内容通常可见到以下几类：

### 一． 材料的来源及合成制备

直接买到的药品一般需指明来源：
**Chemicals** <小标题>
Amino acid (Bachem), 2-(2-amino-ethyl)pyridine (Fluka) and 2-hydroxypyridine (Acros) **were used as received**.

$ZnEt_2$ **was purchased from** Aldrich and was used as received.

直接购买的溶剂等辅助药品只需简单提及或略过：
All other materials **were commercially available and used as received unless otherwise noted**.

All other chemicals **were of analytical grade** and were used as received.

经纯化处理的药品一般需说明纯化方法：
**Materials** <小标题>
Cyclotrimethylene carbonate (Ingelheim, Germany) **was purified by distillation** in vacuo and **recrystallized from** THF.

…was dried and **distilled over** $CaH_2$ twice under reduced pressure.

Ethylacetate was dried over $K_2CO_3$ and distilled.

All solvents **were freshly distilled before use**.

合成的产物要说明具体合成方法：

ɣ-Benzylglutamate **was prepared by the method of Gutmann and Boissinnas** [10].

…was synthesized **according to Ref.** [4].

…were synthesized **according to published procedures** [1].

Trimethylene carbonate **was synthesized following a procedure described elsewhere.**[25] The product was recrystallized twice from diethyl ether. White crystal **was obtained in 55% yield**: mp 45°C). The $^{1}$H-NMR spectrum (4H, 4.50 ppm; 2H, 2.21 ppm) **was consistent with that reported previously**.[25]

Novozym-435 (2.0 g) **was suspended** in 25 mL of nanopure water **in a 100 mL round-bottomed flask fitted with a water cooled condenser**. The lipase suspension **was refluxed** for 14 h. The suspension was then **allowed to cool to room temperature**, and **water was removed by freeze drying**…. The reaction vials **were capped tightly and shaken vigorously** for a few minutes. The reaction vials **were then placed in a constant-temperature water bath** maintained at 37 °C for 3 h with magnetic stirring….

Pentaerythritol (50.0 g, 0.36 mol) and p-toluene-sulfonic acid monohydrate (0.61 g) **were dissolved in** 500 mL of N, N-dimethylformamide **at about 80 °C**, **and then** the mixture **was allowed to cool undisturbed**. **When** the solution **cooled to about 40 °C**, **stirring was started** and 55.4 mL of 2,2-dimethoxypropane (0.36 mol) **was added**. **After stirring for 24 h at room temperature**, the solution was stirred at room temperature with 9.0 g of based-treated DOWEX 1XZ-100 ion exchange resin for 1 h **and filtered**, and then **the solvent was evaporated under reduced pressure** below 85 °C. …**After the treatment** with this resin, the dry product **was ground and extracted**, **first with** light petroleum ether (bp 40-60 °C) for 6 h **and then with** diethyl ether for 12 h, **collected and dried**. Yield: 40.0 g, white crystals (61.9 % of theory); mp 124.5-125.5 °C. $^{1}$H-NMR (300 MHz, DMSO-$d_6$): 1.28 ppm (s, 6H), …

Synthesis of Cyclic Carbonate Monomer <小标题>

Triethylamine (84.0 g, 0.825 mol) **was added dropwise to** a solution of 1,3-propanediol (29.9 g, 0.393 mol) and ethyl chloroformate (85.4 g, 0.786 mol) in 2L of THF at 0 °C **over a period** 30 min. The reaction mixture **was stirred for 2h at room temperature**. Precipitated triethylamine hydrochloride salt **was filtered off**, and **the filtrate was concentrated** under vacuum. The residue **was recrystallized three times from** THF-ether.

1000 g of glycolic acid **was placed in a three necked flask fitted with a stirrer, distillation head and condenser, a thermalmeter for monitoring the temperature of the melt, and a nitrogen bleed**. 1 g of $Sb_2O_3$ **was added** and the vessel **was heated** to 120 °C. Polycondensation began and as the rate of water elimination fell, **the temperature was increased to** 180 °C and

**pressure reduced gradually** from 760-5 mmHg **over a period** of 4-6 hours….

**The structure** of $^{C}$HTC **was confirmed by** FTIR and $^{1}$H-NMR.

## 二． 仪器表征

<各测试仪器型号 、参数均根据具体实验而定， 以下例子仅限于具体文献，不可照抄。>

**Nuclear Magnetic Resonance (NMR) Spectroscopy**
**$^{1}$H-NMR spectra were recorded on** a Bruker ARX-250 spectrometer at 250 MHz.

**Fourier Transform-Infrared Spectroscopy (FTIR)**
A P-E 1720 FTIR spectrometer **was used to obtain the spectra** (16 scans, resolution 2 $cm^{-1}$) of the monomer and polymers **over the range from 4000 to 400 $cm^{-1}$**.

**Differential Scanning Calorimetry (DSC)**
Differential Scanning Calorimetry (DSC) **was carried out with** a Perkin-Elmer DSC 7 thermal analyzer. All the samples were heated **at 20 °C/min heating rate from 25 °C to 200 °C for the first scan**, then cooled at 50-100 °C/min to 25 °C, and immediately heated a second time. Peak melting temperatures ($T_m$) and melting enthalpy ($\triangle H_m$) **were measured on the first scan**, and glass transition temperatures ($T_g$) were measured on the second scan.

DSC was measured using a Perkin-Elmer DSC 7 calorimeter **with heating and cooling rates of** 10 °C/min from -20 °C to 200 °C.

**Scanning Electron Microscopy (SEM)**
Fiber samples were **fractured in liquid nitrogen to obtain tidy cross-section, and then sputter-coated with gold and visualized by SEM** (PHILIPS XL 30).

Samples were then **covered by an ultrathin layer of gold and observed and micrographed with a scanning electron microscope** (JSM 6400).

**X-ray Analysis**
Wide-angle X-ray scattering of a solution cast film aged for 2 weeks at 40 °C **was performed using** a Philips Vertical Diffractometer with Bragg-Brentano geometry and a graphite diffracted beam monochrometer at 40 kV/20 mA and Cu Ka radiation (1.5405 Å). A scanning speed of 2°/min with a sample interval of 0.05° was used.

**Gel Permeation Chromatography (GPC)**
**GPC analyses were carried out using** a Waters HPLC pump with an ERMA 7515A refractive index detector and a Carlo Erba UVIS 20 ultraviolet detector.

**Molecular weight data was obtained** by gel permeation chromatography (GPC), using two PL gel columns connected to a Water 410 RI detector (Waters Corp, MA).

**Molecular weights and the distributions were estimated** by gel permeation chromatography (GPC).

**Thermogravimetric analysis (TGA)**
Thermal stability was evaluated by a TGA 951 (TA instruments) at a heating rate of 10 °C.

### 三． 各种性能测试

<各测试方法均根据具体实验而定， 以下例子仅限于具体文献，不可照搬。>

**Melting Point**
Melting points (mp) **were measured by** a Yanaco micro melting point apparatus.

Melting point data **were obtained in** capillary tubes and are uncorrected.

**Mechanical Properties**
Thin (approx. 0.1 mm) compression molded copolymer films **were tested on** a Sintech 5/D tensile tester according to ASTM standard D882-91 at room temperature.

**Water Uptake**
Polymer films (1 cm x 2 cm x 0.1 mm) **dried in a vacuum oven** (<3mmHg, 40 °C, 24 h) were placed in deionized water at room temperature. After 50 h, the samples were taken out from the deionized water, **excess water** at film surfaces **was gently removed** using Kimwipes, and the films were weighed.

**Solubility Test**
**The tests were carried out** at room temperature by placing approximately 50 mg of product in 5 mL of solvent, agitating using a wrist action shaker for 1 h, **and then making assessments based on visual inspection.**

**Rheological Behavior**
The rheological behavior of dope solution was tested by ARES Rheometric Scientific Rheometer. The experiment was carried out using a 25mm cone-plate fixture at 25 °C.

测试内容根据具体科研工作而定，由于测试种类繁多，不再一一列出。

## ● Results and Discussion

论述普遍现象通常用一般现在时，有时也用一般过去时；注意在同一段落中要避免时态跳跃，但这不是绝对的。

**Results and Discussion 的内容是说明实验现象，报告实验结果；分析实验数据，**

## 阐明自己的观点。

### 一．实验现象、数据和结果的论述

1． 各类仪器测试结果的论述、分析：

**NMR**

Figure 1 shows the 300 MHz $^{1}$H-NMR spectrum of [G-3]-Br **in which three main regions can be seen**. **The resonances for** the exterior phenyl **groups occur at** 7.25-7.45 ppm, the resonances for the aromatic protons of the monomer units **occur in the region** 6.50-6.70 ppm, **separate resonances are observed in the appropriate ratio** for each "layer" of monomer units, and at high field, resonances for the methylene protons occur in the region 4.90-5.10 ppm. In addition, **the methylene resonance for** the unique $–CH_2Br$ functional **group** at the focal point of the dendritic wedge **is seen at** 4.40 ppm.

In the $^{13}$C NMR spectrum the resonances of the quaternary C-atom and of the C-atom in the carbonate group **are shifted to lower field** compared to the monomer, while the resonances of C-atom of the methylene groups **are shifted to higher field**.

**FTIR**

**FTIR analysis showed that the products contained –OH group (3400 $cm^{-1}$)** and $COO^-$ group (1650 $cm^{-1}$, 1400 $cm^{-1}$).

The typical FTIR spectrum of 2a is shown in Fig. 2. **The presence of carbonate group** (C=O) in the polymer backbone **is supported by the strong absorption peak at** $\nu$ **=1746 $cm^{-1}$**, and the two peaks at $\nu$ =1262 $cm^{-1}$ and 1116 $cm^{-1}$ **are ascribed to** ester (CO(C=O)CO) and ether linkage (COC), respectively.

**The band at** 1685 $cm^{-1}$ is $\nu_{C=O}$ of -COOH group and band at 1759 $cm^{-1}$ is $\nu_{C=O}$ of $CH_3COO$- group. The broad band around 3000 $cm^{-1}$ can be attributed to $\nu_{O-H}$ of carboxyl and $\nu_{C-H}$ of acetoxy.

**DSC**

Considering the same thermal history of the prepared samples, **the results of the second heating run are discussed**. Copolymer L6 **exhibits melting endotherms at 43.3 and 169.3 °C**. A decrease in melting points compared with parent PEO and PLLA homopolymers is due to their incorporation into a block copolymer and indicates partial phase compatibility, in agreement with data in the literature [9,16]. **The endotherm at 43.3 °C corresponds to the melting of crystalline regions** of PEO segments only, thus indicating the presence of a separated PEO phase with a certain degree of crystallinity. In the copolymer with shorter PEO segments (L3), **no melting endotherm was observed**. This is might be due to an increased phase compatibility of a short PEO block within dominant PLA blocks and insufficient phase separation.

A broad endotherm appearing **in the first heating run is not reproducible in the second heating curve.**

**Upon first heating**, **we observed** two melting transitions at 88 and 188 °C, **while at second heating** only one transition at 188 °C can be observed.

**As a result of the crystallinity of the samples, the glass transitions can hardly be identified at the first heating cycle**. At the second heating a mixed phase glass transition is observed.

**SEM**

Figures 1-4 show the SEM pictures of cross-sections, outer surfaces, outer edges and inner surfaces of hollow fiber membranes spun with different shear rates. As shown in Figure 1, **there is no obvious difference** among the overall morphologies of the fibers with different shear rates under this low magnification. The finger-like **macrovoids can be observed** for all the fibers. With a higher magnification, Figure 2 illustrates the outer skin morphology. **No visible defects can be observed** in outer skin. …From the outer edges shown in Figure 3, the thickness of the dense layer, varying from about 300 Å to 800 Å, can be found increasing with increasing shear rate. …Figure 4 exhibits that the inner surfaces of hollow fibers **are porous**,…

…**Shows a homogeneous structure** in SEM.

…**exhibits a heterogeneous structure** because of the phase separation.

**At a higher resolution, a tendency to form an organized structure can be found** in some of the PEO domains.

**WAXS**

Figure 4 **shows the powder scattering data over the 2 θ range from 14 to 32 °** . Both the 7:3 and 9:1 copolymers **have WAXS patterns** [Fig. 4(a) and (b), respectively] with **poorly resolved crystalline reflections superimposed on amorphous halos, indicating poorly formed crystals**. The PDOXTC homopolymer [Fig. 4(c)] **has more pronounced and better resolved peaks** than the corresponding copolymers, **indicating a higher level of crystallinity and crystalline order**.

**TGA**

The thermal stabilities of P($^{c}$HTC) and PTMC were compared by TGA (see Figure 5). **The onset of decomposition temperatures** for P($^{c}$HTC) and PTMC were 300 and 260 °C, respectively. Our result on the thermal stability of PTMC was consistent with a previous report. [37]

From the TGA curve, **5 % weight loss was found at** 453 °C.

2. 各种图表的说明、解释：

图：

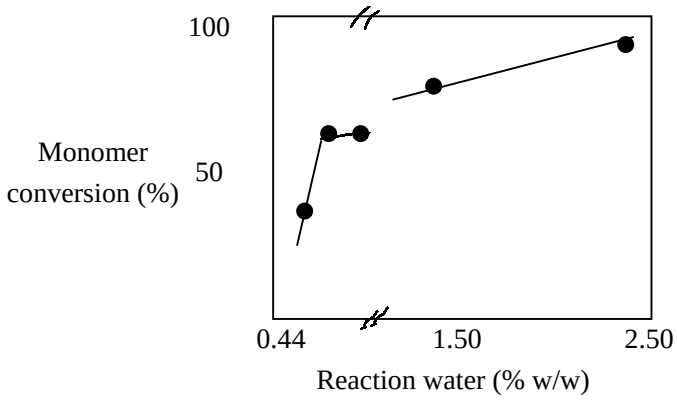



Figure 7. Percent monomer conversion as a function of reaction water content (% by weight) for bulk polymerizations at 70°C for 24 h.

The water content for Novozym-435-catalyzed TMC polymerization reactions conducted at 70°C for 24 h was varied by using four different methods to dry the enzyme. Monomer conversion as a function of total reaction water content (% by weight) **is plotted in Figure 7**. **Increasing** the water content **resulted in enhanced** polymerization rates For example, **by increasing the reaction water content from 0.68 to 2.49%, the monomer conversion increased from 62 to 93%.** Interestingly, **a small increase** in the water content from 0.48 to 0.52% **resulted in a rather large increase** in the percent monomer conversion, i.e., from 40 to 61%. These observations are similar to those made for PS-30-catalyzed polymerizations and can be explained in a similar fashion.[14] In summary, we proposed that, by increasing the total water in reactions, polymerization rates may be increased due to an increase in the number of propagating chain ends. Also, increased water content in the system may result in enhanced enzyme activity. [14]

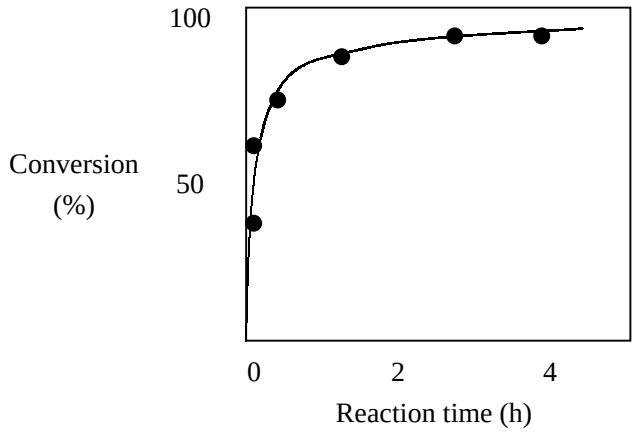



Figure 1. Polymerization of glycolide at 220°C for 24 h with stannous octoate.

The results show that 80% conversion **takes place within** the first 30 min, and **an additional** 3.5 h yields a further 16% conversion. After 4 h, 4% monomer remains, i.e. 96 % is the limit of the polymerization.

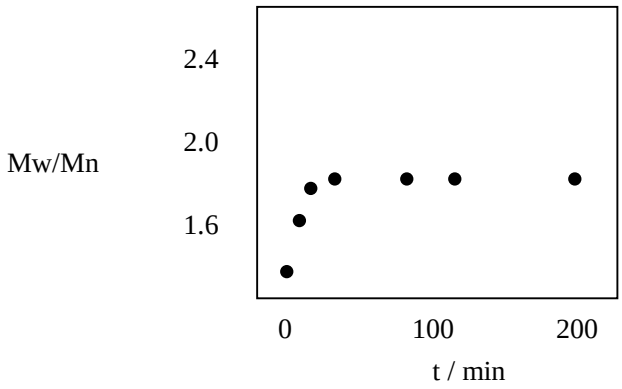



Figure 7. Mw/Mn as a function of polymerization time *t* for the polymerization of DTC with sec-butylithium in toluene as solvent.

With respect to the molecular weight distribution (Fig. 7) **a constant value** Mw/Mn around 1.8 **is reached** after a short reaction time for DTC.

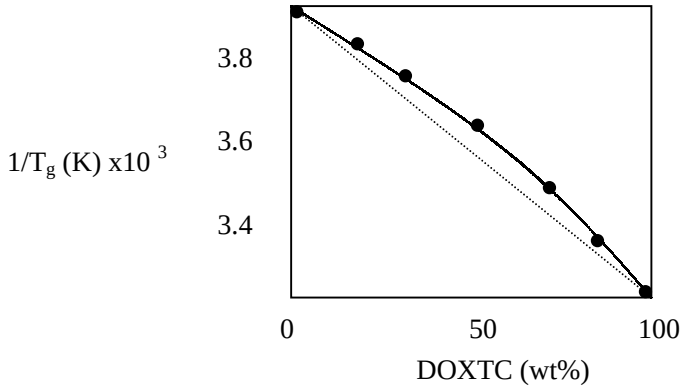
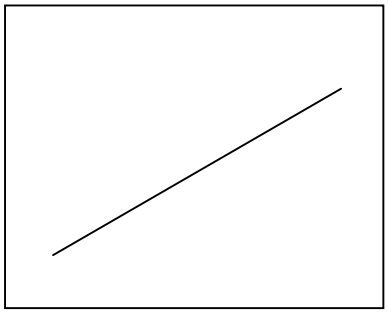



Figure 2. Plot of $1/T_g$ versus the wt% DOXTC for DOXTC-TMC copolymers of variable composition.

The experimental data points from a plot of $1/T_g$ (K) versus DOXTC copolymer content (wt%) **appeared linear** (Fig. 2). **Comparison of the experimental data points to the theoretical dashed line obtained by using the Fox equation showed they were in good agreement** (see Fig. 2). These results support the formation of random copolymers of DOXTC-TMC where the steric requirements of the copolymer repeat units are similar.




线性坐标：

Clearly, there is a linear relationship between Y and X.

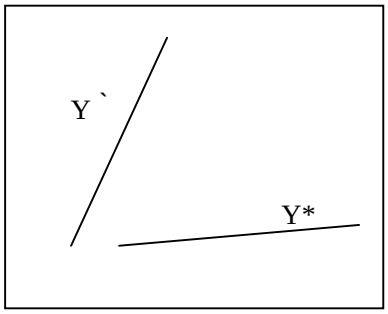
Figure n presents Y increases linearly with X.

Plotting Y as a function of X results in a linear correlation as shown in Fig. n.

指数坐标：

As X is increased, Y increases in an exponential fashion.

Y increases with increasing X, following a power law with the power index of m.




Y ` increases dramatically with increasing X.

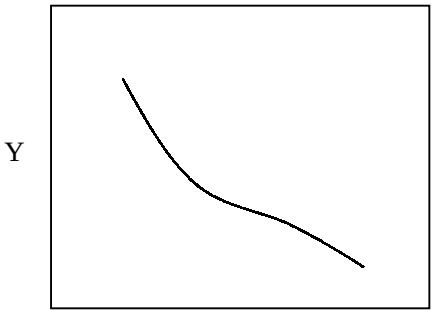
Y ` is steeply increased as X is increased.

Y ` increases rapidly as X is increased.

Y ` increases abruptly with X.

Y* increases slowly with X.

Y* increases slightly with X.




Y decreases with increasing X.

Y is decreased as X is increased.

Y decreases as X is increased.

As a general trend, Y decreased as X increased.

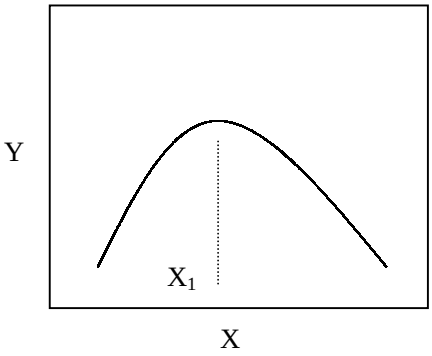
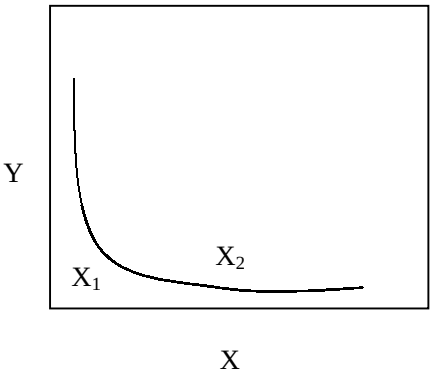



Fig. n demonstrates that the maximum Y appears at $X_1$.

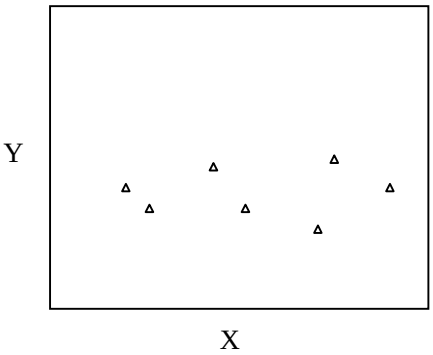
Fig. n shows Y reaches a maximum value at $X_1$.

Y values pass through a maximum (Fig. n ).

The change of Y as a function of X clearly shows that in this case a maximum is passed through.




As the results in Fig. n demonstrate, Y is reduced rapidly after $X_1$ and remains constant at this level after $X_2$.




As can be seen, Y does not strongly depend on X.

The trend is not clear.

The effect of X on Y is not clear.

Y varies from $Y_1$ to $Y_2$ within the X range of $X_1$-$X_2$.

通常用以描述图的语言还有：

**In the region of** 0-6 mole% PEG, where overall FN bioactivity remains uniformly high, the specific bioactivity **increased monotonically with** PEG concentration (Fig. 4b), **whereas** the surface topography (as revealed by AFM) **exhibited a biphasic dependence on** PEG concentration. One of the possible mechanistic explanations for our observation may be that…
**In contrast, for the high PEG regime** (above 8 mole% PEG), FN adsorption **elicited little change** in surface topography….Furthermore, a few adsorbed FN molecules may have reduced the overall surface roughness slightly by serving as “cavity fillers” in the sparse DTE areas bridging PEG domains.

Cell attachment **exhibited a sigmoidal dependency** on PEG concentration, **which was analogous to** the dependence observed for the overall FN bioactivity.

**In contrast to the sigmoidal dependence** of cell attachment on copolymer PEG concentration, the cell adhesion strength values **decreased linearly with** PEG concentration. It is noteworthy that **a similar nature of PEG dependence was observed** for the total amount of fibronectin adsorbed. …In deed, such a linear dependence on ligand concentration has been shown experimentally for osteoblast adhesion strength and …

表格：

Table 1. The dependence of the quantity of immobilized ovomucoid on initial molar ratio [EDC]:[ovomucoid].

| Initial ratio [EDC]:[ovomucoid] | Quantity of immobilized ovomucoid ( μ g/cm$^2$ of surface) |
|---|---|
| 3 | 0 |
| 5 | 0 |
| 10 | 0.03 |
| 100 | 0.1 |
| 1000 | 0.3 |

The dependence of the amount of immobilized ovomucoid onto graft copolymer on the initial molar ratio [EDC]:[ovomucoid] **is presented in Table 1**. It is seen that **the increase** of the initial concentration of EDC **results in the increase** of the amount of immobilized ovomucoid. Besides, it could be seen that **there is a threshold initial concentration** of EDC below which immobilization does not take place.

通常用以描述表格的语言还有：

As **the results in Table 3 show, at higher initiator concentrations and reaction temperatures high conversion and high molecular weights are reached**, but the Mn values obviously pass through a maximum. **It is evident**, **that besides** the previously mentioned reversible equilibrium between polymer and cyclic ester, irreversible degradation reactions **also play a role**, which appears very clearly under certain conditions. The ring-opening polymerization proceeds with a **considerably higher** reaction rate with diglycolide **than** with D, L-dilactide. **In agreement with** Gilding and Reed the reactivity of the diglycolide **is ~ 15 times higher than** that of the D, L-dilactide.

The exponent and constant of the viscosity equation **are changed in opposite directions** (Table 5). Comparable viscosity values **may correspond to** different molecular weights. A small monomer or oligomer content **decreases** the solution viscosity **to a lesser degree than** the Mn value.

**The results in Table 1** of the ring-opening polymerization of D, L-dilactide at 130 °C in the presence of different initiators **show that** certain tin(II) compounds were especially active. **In the literature, partly contradictory results and controversial discussions are found concerning** the mechanism of coordinative-chemical initiated or catalyzed ring-opening polymerizations and the influence of different reaction conditions. **The number of unanswered questions rises if copolymers are included**. A basic prerequisite to achieve a high degree of polymerization is the use of very pure monomers. They should not contain any impurities that initiate additional chains, or hinder the build up of chains by forming non-reacting end groups.[10] So, the content of free carboxylic groups in the monomer should not exceed a value of 0.08m eq/g. The reaction temperature and the initiator concentration **have a great influence on** the reaction rate and on the nature of the products formed. The course of monomer conversion with time at different temperatures shows that **an increase in temperature results in the expected acceleration** of the polymerization; **a nearly complete conversion** at an initiator concentration of $5x10^{-5}$ mole/mole dilactide **is apparently only reached at t ⩾150°C**. **Somewhat surprising is** the influence of temperature in the range 130-180°C on the attainable average molecular weight of the polyester. **As can be seen**, a rise in temperature, connected with an increase in the reaction rate, results in an unexpected rise of Mn values. …**It is reversed by returning to lower temperatures**. **The results in Table 2 make it clear that**…distinctly higher Mn values are reached at 130°C. Table 2 also shows that an acceleration of the reaction by increasing initiator concentration **leads again to** the formation of higher molecular weight products. This effect is unusual in polymerization reactions.

…**are listed in Table n**.

…**are summarized in Table n**.

…**are compared in Table n**.

3. 方程式及数学推导：

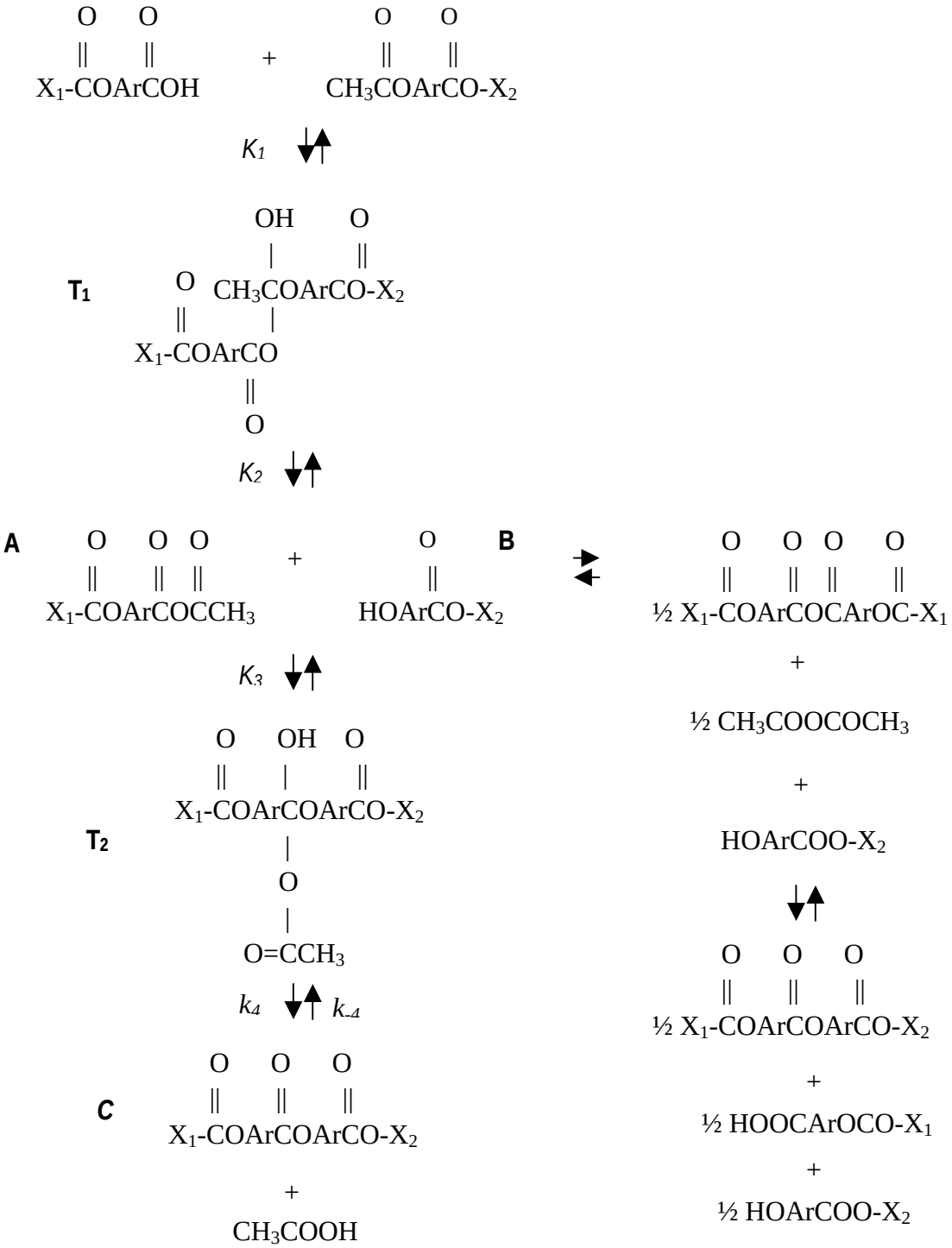
方程式的说明:

For isothermal crystallization, the overall crystallization process **can be described by Avrami equation:**

$1-\theta = \exp[-Kt^n]$ (1)

**where** $\theta$ **is** the relative crystallinity at time *t*, *n* is the dimensionality of crystal growth, and *K* is a temperature-dependent constant that depends on the growth geometry, the number of nuclei present, and the linear growth rate of polymer crystals. A straight line is obtained when $\log[-\ln(1-\theta)]$ is plotted versus log (*t*), from which *n* can be obtained as the slope and log(*K*) as the intercept.

The acidolysis mechanism is illustrated in the following scheme:




$X_1$: $CH_3$ or oligomer or polymer
$X_2$: H or oligomer or polymer
Ar: Benzene or naphthalene ring

From the scheme of the acidolysis mechanism, **we can obtain the following reaction rate equations**:

$K_1 = [T_1]/[COOH][CH_3COO]$ (1)

$K_2 = [A][B]/[T_1]$ (2)

$K_3 = [T_2]/[A][B]$ (3)

$-d[COOH]/dt = k_4[T_2]-k_{-4}[C][CH_3COOH]$ (4)

where $K_1$, $K_2$, $K_3$ are reaction equilibrium constants, and $k_4$, $k_{-4}$ are the reaction rate constants for the corresponding reactions, $A$, $B$ and $C$ are the mediate products, and $T_1$ and $T_2$ are the intermediates as indicated in the scheme. $[COOH]$ is the concentration of acid group. **The concentration of the acetic acid $[CH_3COOH]$ in the reaction system is assumed to be zero** because it is immediately released as soon as it is generated. **So we have**:

$-d[COOH]/dt = k_4[T_2]$ (5)

**Combining eqs. 1-5, we get**:

$-d[COOH]/dt = K_1 K_2 K_3 k_4 [COOH][CH_3COO]$ (6)

Because $[COOH]=[CH_3COO]$, eq. 6 becomes:

$-d[COOH]/dt = K_1 K_2 K_3 k_4 [COOH]^2$ (7)

**The extent of polymerization reaction $P$ is defined as** the ratio of the reacted functional groups to the total functional groups:

$P = ([COOH]_o-[COOH])/ [COOH]_o$ (8)

where $[COOH]_0$ is the initial concentration of acid group and the value is 10 mol/L for this reaction.

**After integrating the combination of eqs. 7 and 8**:

$1/[1-P] = 1+ K_1 K_2 K_3 k_4 [COOH]_o t$ (9)

Reaction rate constant is defined as:

$k = K_1 K_2 K_3 k_4$ (10)

And the number average degree of polymerization $DP$ is defined as the ratio of initial acid group concentration to the current acid group concentration:

$DP = [COOH]_o / [COOH] = 1/(1-P)$ (11)

**From the above deduction**, this reaction is confirmed to be a bimolecular second-order reaction:

$-d[COOH]/dt = k[COOH]^2$ (12)

$1/(1-P) = 1+k[COOH]_o t$ (13)

## 二．自己观点的阐明

表示比较肯定的结论：

**Our results confirm that** the reaction of …does not furnish…, **in contrast to widely cited report** by Konig and Geiger. Rather, **our results establish** that Kohig and Geiger obtained low molecular weight…<语气不够委婉>

**It must be emphasized that**, **due to** the special biodegradation mechanism of PECs, comparisons of biodegradation of particular PECs can only be made using the same shape and amount of implantates at the same implantation site.

This effect, which is unusual in polymerization reaction, **has always been observed** within the temperature investigated.

**A careful study of … revealed that**…

**It must be pointed out that**…

**These results clearly indicate that**…

**Our studies indicate that**…

**Therefore, it is reasonable to postulate that**…

**Therefore, we may conclude that**…

**It appears clearly that**…

**This means that**…

**This elucidates that**…

**This suggests that**…

**The cause for this is certainly** …

**Clearly,** …

**Definitely,** …

表示与期望相符:

**As expected**, copolymers became softer and lost much of their stiffness and strength in the wet stage. Generally, copolymers containing more than 5 mol% of PEG were flexible.

**This is in accordance with** the results discussed in the pervious chapter and supports the proposed degradation mechanism for the PHAC's.

…**is in good agreement with**…

**These observations are consistent with** …

表示与期望相反:
**Surprisingly**, our result does not show the same trend reported in the pervious references [3,4].

表示否定及未来工作期望:
From these results we can conclude that the presence of primary amines has a significant toxic effect on the red blood cells….**This means that it is very unlikely that** these polymers can be used as vectors for vivo use.

**All preliminary attempts to elucidate the polymerization mechanism failed**.

**It is unknown that**…. This, together with…, **is an area requiring additional study**. **Nevertheless, one of most significant findings of our study is that**…

**With regard to…, no unambiguous conclusion can be drawn from the present results**.

… **is not well understood currently and this is an area warranting further study**.

…**is not fully explored and/or understood**.

**This can be little doubt that**…

表示可能:<注意各类表述的程度有所不同>
**It is expected that** this ring-opening reaction of six-membered cyclic carbonate can be utilized not only for the synthesis of carbonate-modified acrylic polymers but also in the development of novel polymers containing carbonate units.

**However, these results do not imply** the absence of an interaction between the particles and the albumin since the solutions become turbid after adding the albumin. **This is probably due to** the formation of ternary complexes.

**This could be explained by** the formation of a monolayer of albumin around the particles, which provides a further stabilization of the complexes.

**There seems to be a relationship between** the amount of positive charges present on the polymer chain and the degradation speed. PHEG, bearing no charges, degrades very fast, having only 12% of its initial molecular weight after 7.5 h. pDMAEG has the highest amount of positive charges under the experimental conditions and its degradation is slowest. After 82 h, the polymer has

retained 52% of its original molecular weight.

…**this could be due to** the presence of the acid functions, preventing a good interaction between the polymer and the cells. The high haemolytic effects of pEI and pLL **are probably due to** the higher charge content. **Maybe** the lower molecular weight of the pLL and pEI **also plays a crucial role, but this needs to be further investigated**.

**The reason for this is not completely clear. An explanation could be** that the pyridine and the acid groups cause an extra buffering of the endosome, resulting in an enhanced release from the endosome. **Further tests need to be done to allow us to draw further conclusions**.

**This could be due to two reasons: 1**…**and/or 2**…

**It is likely that**…

**This is plausible**, since…

…**might be ascribed to**…

# ● Conclusions

时态根据具体内容而定。论述所做的研究工作通常用一般过去时；论述普遍现象通常用一般现在时，有时也用一般过去时。

**Conclusions 简述研究内容，强调实验结果。**<跟 Abstract 可能有部分重复。与 Abstract 的区别是 Abstract 也要强调研究内容。>

以叙事为主的风格<较常用>：

Through in situ observation during the polymerization reaction of a thermotropic main-chain LCP under ac electric fields using a polarizing microscope, **we studied** the effects of external fields on the dynamic response of LC phases in detail. After the appearance of the LC phase, electric fields with different voltages and different frequencies were applied to the polymerization system. The frequency and the strength of an external field determine the dynamic response and LC morphology. In the low-frequency region, a low voltage tends to induce molecular orientation, while a high voltage results in dynamic scattering. In the medium-frequency region, electrohydrodynamic flow can be clearly observed. With further increasing frequency, no visible change is found in a relatively large voltage range because the molecular director in LCP phase cannot response so fast. Because of the continuous changes in viscosity, elastic constants and conductivity during the polycondensation reaction, the electric response of the LC phase changes with the reaction time accordingly. Under a certain voltage, the low and high bounds of electrohydrodynamic flow regime decrease with increasing reaction time.

强调自我的风格：

**In this study, we designed** small increments in the PEG concentration of copolymers to explore the effect of PEG on the biological responsiveness of biomaterials. In a narrow PEG concentration range, we report that the PEG concentration had a strongly regulatory effect on key cellular responses. **We report that** the specific bioactivity of adsorbed protein had a biphasic dependence on PEG concentration…. **Additionally, our studies highline** the role of protein-PEG interfaces with graded adhesion strength in controlling the rate of cell migration. **Overall, our work offers a new paradigm** whereby, the presence of low surface concentration of PEG on biomaterial surfaces may regulate the onset and dynamics of cell adhesion phenomena. **These observations could have important implications** in tissue engineering, particularly for design of substrates that elicit a high degree of cell attachment while optimizing the rate of cell migration. **Furthermore,** since the conformation of adsorbed cell adhesion protein can play a crucial role in determining whether cells proliferate or differentiate [46], the presence of small amounts of PEG on biomaterial surfaces **may also prove useful** to switch the balance between cell growth and differentiation.

以下句式经常可在此部分见到：

**The results obtained in this work allow the conclusion that**…

**In conclusion** ,…

**In summary, from the results obtained up till now, the following can be stated**:…

## ● Acknowledgements

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Many thanks to all those who were involved in this work, with particular gratitude to Dr….for…, Dr….for…, and Dr. …for….

Thanks also to … for generous advice and help.

## ● References

参考文献数目一般在 10-50 篇左右。其格式根据准备投稿的杂志而定，注意文章和书的格式有所不同。

参考文献主要是引用与自己研究工作密切相关的文献，也可适当考虑多引用自己导师 、同事 、同学的文献。

注意不要卷入学派纷争。这点跟以实验为主的文章关系不大，但有些需要理论解释的文章要注意。

还应注意不要遗漏该引用的文献。<如在文章中提到某观点，就要具体指出其出处。>