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The Effect of The Molecular Weight on The Static Electro- Optic Properties of Methacrylate Based Side-Chain Liquid Crystal Polymers

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Abstract

A series of methacrylate based side chain liquid polymers have been prepared with a range of molecular weight. For the high molecular weight polymers , a smectic phase is observed with a very narrow nematic range .

However at low molecular weight only the nematic phase is observed. A Marked reduction in T_g , T_{sn} and T_{ni} a function of reducing the molecular weight have been observed . Infrared dichroism measurements- have been made to determine the order parameters of the Liquid crystslline side chain polymers. It is found that the higher the molecular weight of the polymer the higher the threshold voltage of the electro- optic response, and the lower the order parameter. The increase in the threshold voltage with increasing molecular weight may be related to the intrinsic curvature elasticity and hence to the coupling between mesogenic units and the polymer.

الخلاصة

تم تحضير سلسلة من البوليمرات الاكريليتيه تختلف عن بعضها بتغير الوزن الجزئي ، البوليمرات ذات الوزن الجزئي العالي أظهرت احتوائها على الطور السمكتي مع ظهور طور نيماتي ضيق جدا .على أية حال فان البوليمرات ذات الأوزان الجزئية الأقل لوحظ فيها الطور النيماتي فقط .انخفاض واضح في درجات الحرارة Tni،Tsn،Tg

مع انخفاض الوزن الجزئي .تم استخدام الطريقة التلونية للأشعة تحت الحمراء لإيجاد عامل الاتجاهية للبوليمرات .وقد وجد أن البوليمرات ذات الأوزان الجزئية العالية تمتاز بفولتية عتبة عالية في استجابتها للمجال الكهروبصري المسلط عليها ولها عامل اتجاهية واطئ .وان زيادة فولتية العتبة مع زيادة الوزن الجزئي تعزى الى معامل المرونه الذاتيه للبوليمر وكذلك الى قوة الربط بين المجموعة النهائية للبوليمرات الى عموده الفقري .

Introduction

The design principles of side-chain crystal are well established (Keller p 1985) . These molecular composites consist of a flexible polymer backbone and a rigid mesogenic unit joined as a side chain to the polymer backbone by means of a flexible coupling chain. Although there were initial suggestions that the spacer chain would decouple the motion of the mesogenic unit from the polymer backbone it is now clear that the relatively short length of the coupling chains will result in some interaction between the the mesogenic unite from the polymer backbone .The theoretical predictions of Warner (Warner & Wang, 1989, Wang, 1987).
And others (Vasilenko 1985) have been substantiated by a number of neutron scattering studies (Keller 1985; Hardouin , 1988) .

In the nematic phase, the coupling in systems based upon methacrylates appears to be negative in the sense that polymer chains lie preferentially perpendicular to the mesogenic units (Keller 1985 , Hardouin, 1988) in contrast to the parallel arrangement in acrylate based backbones. For the smectic phase , the density of the layered structure of the mesogenic units acts to confine the polymer chain to a layer perpendicular to the mesogenic units (Keller, 1985; Kirste, 1985; Al-Ammar, 2003; Hardouin;1988).

By suitable chemical design, polymers can be synthesized that will although there is some possibility of interlayer hopping by the polymer chain exhibit (Noierz, 1988; Ringsdorf ,1982) ,the well known electric and magnetic filed effects displayed by low molar mass counterparts (Ringsdorf, 1982).In such electro-optic effects, what is the role of the polymer backbone ?.It is clear that the polymeric nature of the liquid crystal phase strongly effects the response times through a highly temperature dependent viscosity . Furthermore the electro–optic response of a side-chain liquid crystal polymer is particularly sensitive to the thermal history of each sample, and this may be related to