INDUCED DIPOLE IN NON-POLAR POLYMERS BY CHARGES TRAPPING SURFACE

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ABSTRACT

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Dipole moment of polar polymers arises from the orientation of the dipole in the field direction and results in orientational polarization. However, there is no dipolar alignment in non-polar polymers. To create the dipolar orientation in non-polar polymers, the presence of defects such as void is necessary. In this study, internal voids were created inside non-polar commodity plastics by two main techniques: first, blowing agent (azodicarbonamide or ACA) compression molding and second, the phase separation technique. The void size and porosity can be controlled by varying blowing agent concentrations and polymer concentrations, respectively. Subsequently, the internal void sizes and shapes were observed using SEM and OM. The dielectric constant and the dielectric loss of voided films were measured as a function of frequency range, 1 kHz to 1 MHz, at room temperature in different % porosities. The apparent dielectric constants of HDPE and PP were fitted with the Serial model while those of PVC were fitted with the Rayleigh model, indicating a 0-3 connectivity of polymer/air composites. Film stretching was performed to study the effect of void shape on the dipole. As a result, stretched voided films can enhance dielectric, piezoelectric and ferroelectric properties. Consequently, the formation of internal voids can be proposed as an alternative method to induce dipole in non-polar polymers.

บทคัดย่อ

วีรวรรณ วีรเมธาชัย : การเหนี่ยวนำไดโพลในพอลิเมอร์ชนิดไม่มีขั้วโดยการสร้างพื้นผิวสำหรับประจุ (Induced Dipole in Non-Polar Polymers by Charges Trapping Surface)
อ. ที่ปรึกษา : ผศ.ดร. หทัยกานต์ มนัสปิยะ และ ศ. ดร. อมาร์ เอส บาล่าร์ 115 หน้า

ไดโพลโมเมนต์ในพอลิเมอร์ชนิดมีขั้วเกิดจากการจัดเรียงตัวของไดโพลในทิศทางของสนามไฟฟ้า ซึ่งก่อให้เกิดการจัดเรียงตัวของโพลาไรเซชั่น อย่างไรก็ตาม การจัดเรียงตัวนี้ไม่เกิดขึ้นในพอลิเมอร์ชนิดไม่มีขั้ว เพื่อที่จะทำให้เกิดการจัดเรียงตัวนั้น จำเป็นต้องมีการสร้างฟองอากาศภายในชิ้นงาน ในงานวิจัยนี้ ฟองอากาศภายในถูกสร้างขึ้นในพอลิเมอร์ชนิดไม่มีขั้วโดยสองวิธีการ วิธีการแรก คือ การขึ้นรูปแบบอัดกับสารทำให้เกิดฟองชนิดอะโซไดคาร์บอนเอไมด์ วิธีการที่สอง คือ การกลับวัฏภาค ขนาดของฟองอากาศและปริมาณการเกิดฟองสามารถควบคุมได้โดยการควบคุมปริมาณสารทำให้เกิดฟองและความเข้มข้นของพอลิเมอร์ตามลำดับ ขนาดและรูปร่างของฟองอากาศจะถูกวิเคราะห์ด้วยกล้องจุลทรรศน์แบบแสงและกล้องจุลทรรศน์อิเล็กตรอนแบบส่องกราด สำหรับค่าไดอิเล็กตริกและค่าการสูญเสียทางไดอิเล็กตริกของตัวอย่างที่มีปริมาณการเกิดฟองแตกต่างกัน จะถูกศึกษาในช่วงความถี่ 1 กิโลเฮิร์ตถึง 1 เมกะเฮิร์ต ที่อุณหภูมิปกติ จากการทดสอบพบว่า ค่าไดอิเล็กตริกของฟิล์มพอลิเอทิลีนและพอลิโพรพิลีนที่มีฟองอากาศภายในเป็นการคอมพอสิตแบบ 0-3 โดยเทียบกับแบบสมการอนุกรม ในขณะที่ฟิล์มพอลิไวนิลคลอไรด์ที่มีฟองอากาศภายในเป็นการคอมพอสิตแบบ 0-3 โดยเทียบกับแบบสมการเรย์ลิช เพื่อศึกษาผลของรูปร่างของฟองอากาศภายในต่อไดโพล ฟิล์มที่มีฟองอากาศภายในถูกยืดดึงเพื่อเปลี่ยนจากฟองอากาศแบบทรงกลมเป็นทรงรี จากการทดลองพบว่าฟิล์มที่ถูกดึงยืดสามารถเพิ่มสมบัติทางไดอิเล็กตริก เพียโซอิเล็กตริกและเฟอโรอิเล็กตริกเมื่อเทียบกับฟิล์มที่ไม่ถูดึงยืด ดังนั้นการสร้างฟองอากาศภายในจึงนับเป็นวิธีการใหม่ในการเหนี่ยวไดโพลในพอลิเมอร์ชนิดไม่มีขั้ว

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