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Perspective

A Brief Note on PVDF-based Dielectric Polymers

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DESCRIPTION

Dielectric materials are electrically insulating and might be polarised by an applied electric field, leading to the accumulation of positive charges on the one side of the dielectric towards the field and negative charges on the alternative side [1]. Dielectric properties of a material are usually examined by using Displacement–Electric field (D–E) loops. Depending on the D–E loops, dielectric behaviour will usually be categorized into four types consisting of linear dielectric, Ferroelectric (FE), Relaxor Ferroelectric (RFE), and anti-FE polarisations. The linear dielectrics show no or little hysteresis in their D–E loops. In contrast, normal FE behaviour is featured by a large hysteresis loop with a relative large remnant polarisation. RFE behaviour has a slim loop, and the remnant polarisation is almost zero when the electrical field is back to zero. Whereas for the anti-FE behaviour, reversible RFE–FE transition happens at the high electrical field.

Depending on the molecular structure and the processing method, PVDF-based dielectric polymers will exhibit rich dielectric polarization behaviours covering FE, relaxor FE, anti-FE-like and linear dielectric responses, which allows a spectrum of application fields like non-volatile, piezoelectric and pyroelectric sensors, actuators, electrocaloric refrigeration, and film capacitors. The chemical synthesis and modification ways for getting numerous fluoropolymers beyond PVDF homopolymer are then summarised with an emphasis on the connection between the molecular structure and the dielectric polarisation behavior [1]. Additionally, the impact of processing strategies on the crystal structure and dielectric properties of the PVDF-based polymers is mentioned.

These appealing properties modify a wide range of applications in energy storage and conversion. Depending on the molecular structure and the process history, PVDF-based dielectric polymers will exhibit rich dielectric polarisation behaviours covering normal FE, RFE, anti-FE-like, and linear dielectric responses [2]. The rich dielectric behaviours of PVDF-based polymers provide numerous application fields like non-volatile memory, piezoelectric and pyroelectric sensors, actuators, electrocaloric refrigeration, and film capacitors. As an example, normal FE β-phase PVDF and its polymer poly(vinylidene fluoride-trifluoroethylene) P(VDF-TrFE) are promising in applications of non-volatile reminiscences and piezoelectric sensors. The defect-engineered poly(vinyl fluoride-chlorotrifluoroethylene) (P(VDF-CTFE)), electron beamed P(VDF-TrFE), and P(VDF-TrFE)-based terpolymers having the RFE characteristics will be used for dielectric film capacitors, electrocaloric refrigeration, and electrostrictive effort. PVDF-based graft polymers with anti-FE-like behaviour are mostly preferred for energy storage within the film capacitors.

This analysis introduces the present practical/promising applications of PVDF-based dielectric polymers, and the corresponding optimum dielectric polarisation behaviour and crystal structure are projected consequently. The chemical synthesis and modification ways for getting numerous fluoropolymers beyond PVDF are then summarised with an emphasis on the connection between the molecular structure and the dielectric polarisation behavior [3]. Additionally, the impact of process strategies on the crystal structure and dielectric properties of the PVDF-based polymers is mentioned.

PVDF-based dielectric polymers are attractive for numerous applications together with non-volatile memory, piezo and pyroelectric sensors, actuators, electrocaloric refrigeration, and film capacitors. Different applications might need different dielectric and FE properties, which require completely different molecular structures, chain conformation and crystal phases. Through chemical synthesis and modification strategies, a series of PVDF-based copolymers, terpolymers, and grafted or cross-linked polymers will be obtained that exhibit rich dielectric polarisation behaviours covering normal FE, RFE, anti-FE-like and linear dielectric responses. Additionally, the process procedure will be controlled to tune the crystal structure and dielectric properties of the PVDF-based polymers [4,5]. Despite much progress has been created for PVDF-based polymers, great challenges still exist in several areas. For example, within the field of film capacitors, although RFE polymers exhibit narrow hysteresis due to which the crystal pinning effect, their low temperature and comparatively low melting temperature limit their use in high-temperature applications.

The anti-FE-like PVDF-based graft copolymers even have limitations to scaling up because of the large quantity of copper catalyst utilized in the grafting process. The recent attention of the

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academic community has focused on the impact of nanoconfinement (e.g. multilayer, template wetting etc.) to enhance the properties of the PVDF-based polymers. Also, the nanocomposite approach is another theme being extensively practised for the tuning of physical properties (e.g. chemical compound crystalline structures and electrical properties like energy storage behaviour and electrocaloric effect) of PVDF-based dielectric polymers.

REFERENCES

1. Correia HMG, Ramos MMD. Quantum modelling of poly (vinylidene fluoride). Comput Mater Sci. 2005;33(1): 224-229.
2. Li M, Wondergem H, Spijkman MJ. Revisiting the δ-phase of poly (vinylidene fluoride) for solution-processed ferroelectric thin films. Nature Mater. 2013;12(5): 433-438.
3. Bune AV, Fridkin VM, Ducharme S. Two-dimensional ferroelectric films. Nature. 1998;391(6670): 874-877.
4. Hu Z, Tian M, Nysten B. Regular arrays of highly ordered ferroelectric polymer nanostructures for non-volatile low-voltage memories. Nature Mater. 2009;8(1): 62-67.
5. Chen XZ, Chen X, Guo X. Ordered arrays of a defect-modified ferroelectric polymer for non-volatile memory with minimized energy consumption. Nanoscale. 2014;6(22): 13945–13951.