

## Crystallization Behavior of PET Materials

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### Abstract

*Polyethylene terephthalate, commonly coded as PET, PETE, is a thermoplastic polymer resin of the polyesters and is used in liquid containers, drinks, food and synthetic fibres. Depending on its processing and thermal conditions, PET may exist both as amorphous and as semi-crystalline. PET may appear opaque, white and transparent depending on its crystalline and amorphous structure. Its crystallinity and consequently its physical and mechanical properties are highly dependent on processing conditions like processing temperature, cooling rate, stretching process etc. In this study, it was tried to summarize all about PET crystallization by referring to all studies carried out before. Crystallization is very significant properties affecting all mechanical and physical properties of PET just as for all kind of polymers. As a result, this subject has taken in very good interest so far and it is believed that this interest will go on increasingly.*

**Keywords:** Crystallization, material properties, PET

## PET Malzemelerin Kristalizasyon Davranışı

### Özet

*Polyethylene terephthalate, PET veya PETE şeklinde kısaltması yapılan, sıvıların, yiyecek ve içeceklerin saklanması ve taşınmasında, sentetik liflerin yapımında kullanılan polyester sınıfından termoplastik polimer bir reçinedir. Termal ve proses şartlarına bağlı olarak, PET amorf ya da semi-kristal yapıda olabilir. Bu özelliğinden dolayı PET donuk, beyaz ya da camımsı bir yapıda olabilir. PET'in kristal yapısı, buna bağlı olarak da fiziksel ve mekaniksel özellikleri büyük oranda işlem sıcaklığı, soğutma hızı, gerdirme işlemi gibi proses parametrelerine bağlıdır. Bu çalışmada, PET'nin kristalizasyonu ile ilgili daha önce yapılan bütün çalışmalar özetlenmeye çalışılmıştır. Tıpkı bütün polimerlerde olduğu gibi kristalizasyon PET'nin bütün fiziksel ve*

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# Crystallization Behavior Of Pet Materials

**Arturo Cuomo**



## **Crystallization Behavior Of Pet Materials:**

**Advanced Engineering Materials III** Jing Long Bu, Yun Hae Kim, 2013-08-30 Selected peer reviewed papers from the 3rd International Conference on Advanced Engineering Materials and Technology AEMT 2013 May 11 12 2013 Zhangjiajie China *Advanced Materials and Process Technology* Xianghua Liu, Zhen Hua Bai, Yuan Hua Shuang, Cun Long Zhou, Jian Shao, 2012-11-12 Selected papers from the 2nd International Conference on Advanced Design and Manufacturing Engineering ADME 2012 August 16 18 2012 Taiyuan China **Plastics Technology Handbook** - Don Rosato, 2010-10-22 This comprehensive handbook provides a simplified practical and innovative approach to understanding the design and manufacture of plastic products It will expand the reader's understanding of plastics technology by defining and focusing on past current and future technical trends Published in 2 volumes the content is presented so that both technical and non technical readers can understand the interrelationships of materials to processes Different plastic products are examined and their related critical factors are shown from meeting performance requirements in different environments to reducing costs and targeting for zero defects Examples used include small to large and simple to complex shapes Information is included on static properties tensile flexural dynamic properties creep fatigue impact and physical and chemical properties Extensive reference sources and useful data and physical and chemical constants are also provided Volume 1 sets out the basic principles of polymers what they are and how plastics are formulated processed and manufactured **High Performance Plastics 2005**, 2005 High performance plastics are replacing traditional materials in hostile environments They possess characteristics such as exceptional strength lightweight temperature resistance usually in excess of 160 C chemical resistance and dimensional stability In addition plastics are relatively easy to process and can be coloured or transparent and moulded to create innovative and attractive structures The fun car market illustrates the increasing use of plastics materials and the versatility and appeal needed in materials for today's marketplace This two day international conference brought together experts discussing the latest developments in materials including properties processing and applications There are many different types of high performance elastomers Their unique properties are essential in hostile environments and application areas include the petrochemical and refining industries automotive aerospace defence wire and cable construction chemical plants nuclear medical food and seals Correct material selection compounding and processing are essential These proceedings have brought together a collection of papers for material suppliers engineers compounders manufacturers processors and end users of high performance elastomers who discussed the most appropriate materials and formulations for different applications Poly(Ethylene Terephthalate) Based Blends, Composites and Nanocomposites P.M. Visakh, Mong Liang, 2015-08-24 Poly Ethylene Terephthalate PET is an industrially important material which is not treated specifically in any other book Poly Ethylene Terephthalate Based Blends Composites and Nanocomposites fills this gap and systematically guides the reader through all aspects of PET and its blends composites and nanocomposites It covers

theoretical fundamentals nanocomposites preparation modification techniques structure property relationships characterisation of the different blends and composites and material choice for specific applications Consisting of contributions from experts in the field this book is a useful reference for the researchers and engineers working on the development and characterization of PET materials as well as on implementing them in real world products It can also be used as a standard reference for deeper insight in the mechanical thermal thermo mechanical and visco elastic aspects in product design decisions Provides a systematic overview on all types of poly ethylene terephthalate PET based blends composites and nanocomposites Informs about characterization structure property relationships and types of modifications Links material properties to specific applications enabling engineers to make the best material choice to increase product performance and cost efficiency in industries ranging from aerospace to energy Polymeric Foams S.-T. Lee,2022-05-18 Polymeric Foams Innovations in Technologies and Environmentally Friendly Materials offers the latest in technology and environmental innovations within the field of polymeric foams It outlines how application focused research in polymeric foam can continue to improve living quality and enhance social responsibility This book Addresses technological innovations including those in bead foams foam injection molding foams in tissue engineering foams in insulation and silicon rubber foam Discusses environmentally friendly innovations in PET foam degradable and renewable foam and physical blowing agents Describes principles as well as applications from internationally recognized foam experts This work is aimed at researchers and industry professionals across chemical mechanical materials polymer engineering and anyone else developing and applying these advanced polymeric materials **Polymers and Other Advanced Materials** Ting Joo Fai,James E. Mark,Paras N. Prasad,2013-11-11 Proceedings of the Third International Conference on Frontiers of Polymers and Advanced Materials held in Kuala Lumpur Malaysia January 16 20 1995 **Conference Proceedings** Society of Plastics Engineers. Technical Conference,1993 *Emerging Materials and Mechanics Applications* Elwin Mao,Wen Ya Tian,2012-03-15 Selected peer reviewed papers from the the 2012 International Conference on Emerging Materials and Mechanics Applications ICEMMA 2012 February 5 6 2012 Hangzhou China **Material Science, Manufacturing Technology and Advanced Design Technology** Qingzhou Xu,2014-03-12 Selected peer reviewed papers from the 2014 International Conference on Materials Science and Manufacturing ICMSM 2014 January 10 12 2014 Yichang China 10th ESAFORM Conference on Material Forming Elías Cueto,Francisco Chinesta,2007-05-10 This book contains papers presented at the 10th Annual ESAFORM Conference which covers the multitude of disciplines related to material forming This year s conference features for the first time an ECCOMAS Thematic conference devoted to new advanced numerical strategies in forming simulation which has been traditionally one of the mini symposia of the conference Mechanical Components and Control Engineering III Wei Min Ge,2014-10-08 Selected peer reviewed papers from the 3rd Asian Pacific Conference on Mechanical Components and Control Engineering MCCE 2014 September 20 21 2014 Tianjin China Technology and Engineering

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**Material Characterization and Modeling of Strain Induced Crystallization in PET Above the Glass Transition Temperature** Gurucharan Chandrasekaran, 2008

Abstract PET is a thermoplastic polymer that is extensively used in the production of packaging material for applications such as drawn fibers bottles and stretched films Its industrial applicability is largely based on the fact that it undergoes strain induced crystallization on deformation just above its glass transition temperature  $T_g$  Crystallization imparts increased density stiffness dimensional stability and resistance to permeability However the crystallization process and the mechanical behavior of PET above its  $T_g$  is highly dependent on factors such as temperature strain rate and the mode of deformation This makes it necessary to have a reliable material model that can be used in FEM simulations to predict its mechanical behavior This thesis is aimed at achieving two goals i to mechanically characterize three PET PCT blends that have not been previously tested PET00 PET1 5 and PET12 and to do a comparative study of the five PET PCT blends This was done by testing five PET PCT blends over a range of temperatures and strain rates in uniaxial compression and plane strain compression modes ii to modify the Dupaix Krishnan constitutive model to predict the occurrence and effects of strain induced crystallization in PET This involved testing PET and PETG under load hold conditions to identify the criteria that induce crystallization in PET Subsequently the material model was modified by incorporating these criteria Monotonic tests were conducted for the five PET PCT blends PET00 PET1 5 PET3 5 PET12 and PETG at temperatures of 90C and 100C and strain rates of 0 1 s 0 05 s and 0 005 s in uniaxial compression and plane strain compression The experimental results were then fit to the Dupaix Boyce constitutive model for these five blends The model was able to successfully capture the dependence of the material behavior on temperature strain rate and strain state above  $T_g$  for the five materials The experimental results were also useful in making a comparison of the mechanical behavior of the five materials to each other This showed that the behavior of the low PCT content materials were different from that of the high PCT content materials at conditions that favored crystallization Load hold experiments were conducted on PET00 PET3 5 and PETG at temperatures of

90C and 100C and strain rates of 0.1 s and 0.005 s in both uniaxial and plane strain compression. The results obtained were similar to that of the monotonic tests as they showed that while PET00 and PET3.5 crystallized at certain favorable conditions, PETG did not. Therefore, it was found that the load hold condition was not one of the factors that lead to crystallization. Crystallization occurred in PET only when all of the following conditions were met: i) high strain rates of 0.1 s and above; ii) temperatures of 90C-100C; iii) plane strain compression; and iv) after a certain amount of deformation. Based on these findings, changes were made to the Dupaix-Krishnan material model to improve its ability to predict the occurrence and effects of strain-induced crystallization on the large strain deformation behavior of PET near  $T_g$ .

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