

# Mechanical properties of photovoltaic polymers





## Overview

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••We constructed a new type of intrinsically stretchable active layer.••.

Photovoltaic cells are devices that can convert sunlight into electrical power and are commonly employed in roofs, windows, greenhouses, space, and other fields [1], [2], [3], [4], [5], [6].

2.1. Mechanical and crystalline properties of thin PM6-OD filmBenefited from the improved polymerization protocol in a prior report of Li et al. [47], PM6-OD exhibit.

In summary, we have reported that mixing two PM6-family polymer donors results in the synergistic optimization of the PCE and mechanical robustness of all-polymer OPVs in a ternary blen.

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Do tensile strains affect photovoltaic properties of organic solar cells?

This paper describes the effect of tensile strains of up to 20% on the photovoltaic properties of organic solar cells based on two different conjugated polymers and their blends with (6,6)-phenyl C 61 butyric acid methyl ester (PCBM).

Can OPV film improve the mechanical and photovoltaic properties?

We synergistic optimized the mechanical and photovoltaic properties of OPV film. We successfully predicted the changes in elastic modulus of the blend film. In recent years, the power conversion efficiency of all-polymer organic photovoltaic cells (OPVs) has surpassed 19%, reaching a level suitable for commercial applications.

What determines the mechanical performance of polymeric materials?

The mechanical performance of polymeric materials is commonly determined by the EAB and tensile strength (TS). (19) Changes in the mechanical property



of the PET samples were tested by a tensile test. The extension rate of test was 10 mm/min.

Are polymerized solar cells efficient?

Soc.143, 2665–2670 (2021). Du, J. et al. Polymerized small molecular acceptor based all-polymer solar cells with an efficiency of 16.16% via tuning polymer blend morphology by molecular design. Nat. Commun.12, 5264 (2021). Sun, H. et al. A narrow-bandgap n-type polymer with an acceptor-acceptor backbone enabling efficient all-polymer solar cells.

Do all-polymer OPVs improve photovoltaic performance and stability?

This study not only improves the photovoltaic performance and stability but also promotes mechanical robustness of all-polymer OPVs. Another feasible method to construct all-polymer OPVs is employing dual polymer donors.

Are all-polymer solar cells better than polymer-fullerene solar cells?

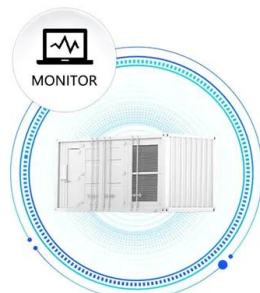
All-polymer solar cells (all-PSCs), consisting of polymer-donor and polymer-acceptor materials, possess many advantages over polymer-fullerene solar cells, including tunable chemical and electronic properties as well as enhanced stabilities 13, 14, 15, 16, 17, 18, 19, 20, 21.



## Mechanical properties of photovoltaic polymers

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### Modeling-driven materials by design for conjugated polymers: ...

1. Introduction Conjugated polymers (CPs) have emerged as critical functional materials in the realm of flexible electronics and optoelectronic devices due to their unique blend of mechanical flexibility, solution processability, and tunable optoelectronic properties. 1-4 These characteristics have driven significant research into their applications in organic field-effect ...

### Optimizing Mechanical Stretchability and Photovoltaic

However, up to now, achieving synergistic optimization of both photovoltaic and mechanical properties has not been ideal. Here, we introduce a long-branched alkyl chain ...



### Toward mechanically robust and intrinsically stretchable organic ...

This paper describes the effect of tensile strains of up to 20% on the photovoltaic properties of organic solar cells based on two different conjugated polymers and their blends ...

### Effects of Flexible Conjugation-Break Spacers of Non-Conjugated Polymer

The effect of FCBSs length on solubility of the acceptor polymers, and their photovoltaic and mechanical properties in all-polymer solar cells



were explored. This work provides useful guidelines for the design of semiconducting polymers by introducing FCBS with proper length, which can greatly improved properties that are not possible to be achieved by ...



### Improved photovoltaic performance and robustness of all-polymer ...

A new polymer donor enables binary all-polymer organic photovoltaic cells with 18% efficiency and excellent mechanical robustness. Adv. Mater. 34, 2205009 (2022).



### Polymer-nanocarbon composites: a promising strategy for ...

The exigency for sustainable and clean energy resources has led to profound research in development of various generations of solar cells, aiming to control the over-exploitation of fossil fuels and subsequently limit environmental degradation. Among the fast-emerging third-generation solar cells, polymer solar cell technology has gained much ...



### Nano-scale mechanical properties of polymer/fullerene bulk ...

DOI: 10.1016/J.SOLMAT.2011.05.039 Corpus ID: 95683003 Nano-scale mechanical properties of polymer/fullerene bulk hetero-junction films and their influence on photovoltaic cells @article{Li2011NanoscaleMP, title={Nano-scale mechanical properties of polymer



### Mechanical properties of the encapsulant material for photovoltaics

A technique based on the tensile testing is proposed for a quantitative characterization of materials with a wide strain range and nonlinear stress and strain dependencies which can be represented as two sequential processes (stages) described in Hollomon power-like approximation. The distinct and unambiguous criterion is developed to ...



### Advanced polymer encapsulates for photovoltaic devices - A review

Blending of the chemically modified bacterial cellulose (BC) nanofibres into EVA matrix has resulted in improved thermo-mechanical properties of EVA film for PV cells, without compromise in its optical transparency [34].

### Mechanical Assessment of Large Photovoltaic Modules by Test ...

The mechanical behavior of PV modules was investigated for four point mounting regarding to the positioning of the clamps and the influence of polymers (e.g. EVA) with their stiffness properties.



### A bending test protocol for characterizing the mechanical

Mechanical flexibility has long been a key attribute of emerging photovoltaic (ePV) devices 1, including organic 2,3, dye-sensitized 4, perovskite 5,6,7,8, quantum-dot ...



### Lifetime Evaluation of Photovoltaic Polymeric ...

Photovoltaic (PV) power generation plays a significant role with the increase of installed capacity of renewable energy. The effects of environmental stress on insulating backsheets have been considered as the ...



### Benzodithiophenedione-based polymers: recent advances in ...

An emerging annelated thiophene of benzodithiophenedione (BDD) has exhibited its distinguished photovoltaic performance since its planar molecular structure, low-lying highest occupied molecular

### Effects of Flexible Conjugation-Break Spacers of Non-Conjugated Polymer

Vol.(0123456789) 1 3 Eects of Flexible Conjugation-Break Spacers of Non-Conjugated Polymer Acceptors on Photovoltaic and Mechanical Properties of All-Polymer Solar Cells  
Qiaonan Chen<sup>1,2</sup>, Yung Hee Han<sup>3</sup>, Leandro R. Franco<sup>4</sup>, Cleber F. N. Marchiori<sup>4</sup>,



### Exploring the Mechanical, Electronic, and Optical Properties of ...

In this study, we present the findings of a comprehensive investigation using first-principles methods to analyze the physical characteristics of the structural, electronic, optical, and elastic properties of the LmGaAs<sub>2</sub> (Lm = In, Eu, Ta) chalcopyrites. The calculated equilibrium parameters exhibit a high level of agreement with the experimental counterparts that are ...



### Impact of Molecular Weight on the Mechanical and Electrical Properties

Understanding the key factors influencing the mechanical and electrical properties of semiconducting polymers is crucial to the development of stretchable electronics. In this work, a high-mobility diketopyrrolopyrrole-based conjugated polymer with varied number-average molecular weights ( $M_n$ ) was used as the model system to explore the impact of ...



### Effects of Flexible Conjugation-Break Spacers of Non-Conjugated Polymer

All-polymer solar cells (all-PSCs) possess attractive merits including superior thermal stability and mechanical flexibility for large-area roll-to-roll processing. Introducing flexible

### Synergistic optimization of mechanical and photovoltaic properties ...

Using multiple donor polymers is a simple means to broaden the absorption range of organic solar cells (OSCs). Yet, achieving improved photovoltaic and mechanical properties in OSCs based on dual polymers has not met with success so far. Here, we address this challenge by introducing a low-cost and 2D semi-p

**12.8V 100Ah**



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Full list of publications (>100 research articles)  
Selected Publications(????) 2024?: 1. Saimeng Li, Mengyuan Gao, Kangkang Zhou, Xin Li, Kaihu Xian, Wenchao Zhao, Yu Chen, Chunyong He, Long Ye\*, Achieving Record-high Stretchability and Mechanical Stability in Organic Photovoltaic Blends with A Dilute-absorber Strategy, *Advanced Materials*, 2024, 36, 2307278.



### **NON-LINEAR MECHANICAL PROPERTIES OF ETHYLENE ...**

25th European Photovoltaic Solar Energy Conference, Valencia, Spain, 6-10 September 2010, 4AV.3.115 1 NON-LINEAR MECHANICAL PROPERTIES OF ETHYLENE-VINYL ACETATE (EVA) AND ITS RELEVANCE TO



### **Unraveling the Correlations between Mechanical ...**

Herein, a range of characterization methods is combined to investigate the mechanical properties, miscibility, and film microstructure of the blends based on several representative polymer donors (PTzBI-Si, PTVT-T, ...

### **Flexible, highly efficient all-polymer solar cells**

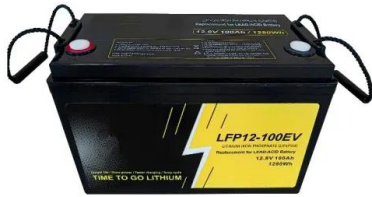
The superior mechanical properties of all-polymer solar cells afford greater tolerance to severe deformations than conventional polymer-fullerene solar cells, making them ...





### Molecular Insights into the Mechanical Properties of Polymer ...

We investigate the mechanical properties of  $\pi$ -conjugated polymeric materials composed of regioregular poly(3-hexylthiophene) (P3HT) and fullerene  $C_{60}$  using coarse-grained molecular dynamics simulations. Specifically, we perform tensile simulations of P3HT: $C_{60}$  composites with varied degrees of polymerization and  $C_{60}$  mass ...



### The effect of rigid-block length in elastomer-containing ...

1 Supplemental Information for The effect of rigid-block length in elastomer-containing photoactive block copolymers on the photovoltaic and mechanical properties of polymer solar cells  
Heung-Goo Lee+,1, Jin-Woo Lee+,1, Eun Sung Oh+,2, Michael J. Lee,3 Taek-Soo Kim2,\*



### Lifetime Evaluation of Photovoltaic Polymeric ...

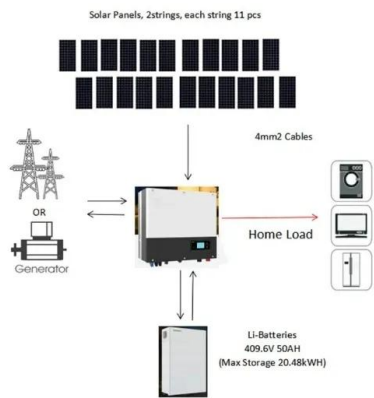
The mechanical performance of polymeric materials is commonly determined by the EAB and tensile strength (TS). Changes in the mechanical property of the PET samples were tested by a tensile test. The ...



### Self-healing polymers in rigid and flexible perovskite photovoltaics

In summary, first, we provide the fundamental chemical bond types of self-healing polymers for PSC applications. Recent years have reviewed many self-healing polymer types, their unique ...





### Molecular Insights into the Mechanical Properties of Polymer

We investigate the mechanical properties of  $\pi$ -conjugated polymeric materials composed of regioregular poly(3-hexylthiophene) (P3HT) and fullerene C60 using coarse-grained molecular dynamics simulations. Specifically, we perform tensile simulations of P3HT:C60 composites with varied degrees of polymerization and C60 mass fractions to obtain their ...

### Development and thermo-mechanical reliability assessment of ...

Fig. 1 (a) shows the schematic build-up of LW mini-modules (2 x 1 cells). The LW PV modules have three essential compositions: the fiber-reinforced polymer backsheet, cell string interconnects, and a polymer frontsheet, which are encapsulated by a commercial



### Molecular Insight into the Mechanical Properties of Polymer

Request PDF , Molecular Insight into the Mechanical Properties of Polymer--Fullerene Bulk Heterojunctions for Organic Photovoltaic Applications , We investigate the mechanical properties of  $\{ \pi$

### 5 Mechanical Properties of Polymers

60 Chap. 5 o Mechanical Properties of Polymers temperatures below and above the  $T_g$  is because they lack a significant portion with a  $T_g$ -Table 5.2 lists polymers and their tendency toward crystallinity. Yield stress and strength, and hardness increase with an





### **Flexible, highly efficient all-polymer solar cells**

The superior mechanical properties of all-polymer solar cells afford greater tolerance to severe deformations Z.-K. et al. Suppressing recombination in polymer photovoltaic devices via energy

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