Flexible organic transistors on standard printing paper and memory properties induced by floated gate electrode

By: Peng, BY (Peng, Boyu)¹; Chan, PKL (Chan, Paddy K. L.)¹

ORGANIC ELECTRONICS
Volume: 15 Issue: 1 Pages: 203-210
Published: JAN 2014

Abstract
Integrating electronic devices with unconventional substrate has been a popular research direction. Among these substrates, cellulose fiber paper has advantages in low-cost, recyclable and bio-degradable. We demonstrated directing printing of all contact electrodes on standard untreated Fuji Xerox printer paper without using planarization layer. The screen-printed gate electrodes based on silver nanoparticles can smooth out the paper substrate surface by two orders of magnitude and allow us to use parylene and DNTT as the dielectric and active layer directly. The transistors show average mobility of 0.297 cm² V⁻¹ s⁻¹ and on/off ratio larger than 10⁵. The low leakage current allows us to demonstrate memory properties by employing the floated gate method. The devices show excellent memory retention time for more than 10,000 s. The unique flexibility and combustibility of the organic transistors on paper substrate manifest their applications as next generation of green electronics. (C) 2013 Elsevier B.V. All rights reserved.

Keywords
Author Keywords: Screen-printing; Cellulose fiber paper; Memory; Floated gate
KeyWords Plus: SELF-ASSEMBLED MONOLAYERS; PERFORMANCE; PENTACENE; HYDROPHILICITY; SEMICONDUCTORS; DIELECTRICS; HYDROLYSIS; ROUGHNESS; CIRCUITS; LAYER

Author Information
Reprint Address: Chan, PKL (reprint author)
Addresses: ¹ Univ Hong Kong, Dept Mech Engn, Pokfulam Rd, Hong Kong, Hong Kong, Peoples R China
E-mail Addresses: pklc@hku.hk

Funding

Table: Funding Agency and Grant Number

<table>
<thead>
<tr>
<th>Funding Agency</th>
<th>Grant Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>University of Hong Kong</td>
<td>201209160033</td>
</tr>
<tr>
<td></td>
<td>201210159031</td>
</tr>
</tbody>
</table>

View funding text

Publisher
ELSEVIER SCIENCE BV, PO BOX 211, 1000 AE AMSTERDAM, NETHERLANDS

Categories / Classification
Research Areas: Materials Science; Physics
Web of Science Categories: Materials Science, Multidisciplinary; Physics, Applied

Document Information
Document Type: Article
Cited References: 40
(from Web of Science Core Collection)

From: Flexible organic transistors on standard printing paper and memory properties induced by floated 
...More
24. Pen-on-Paper Flexible Electronics
By: Russo, Analisa; Ahn, Bok Yeop; Adams, Jacob J.; et al.
ADVANCED MATERIALS Volume: 23 Issue: 30 Pages: 3426+ Published: AUG 9 2011
Times Cited: 100
(From Web of Science Core Collection)

25. Flexible organic transistors and circuits with extreme bending stability
By: Sekitani, Tsuyoshi; Tschieschang, Ute; Klauk, Hagen; et al.
NATURE MATERIALS Volume: 9 Issue: 12 Pages: 1015-1022 Published: DEC 2010
Times Cited: 228
(From Web of Science Core Collection)

26. Foldable Printed Circuit Boards on Paper Substrates
By: Siegel, Adam C.; Phillips, Scott T.; Dickey, Michael D.; et al.
ADVANCED FUNCTIONAL MATERIALS Volume: 20 Issue: 1 Pages: 28-35 Published: JAN 8 2010
Times Cited: 154
(From Web of Science Core Collection)

27. Relationship of Surface Hydrophilicity, Charge, and Roughness of PET Foils Stimulated by Incipient Alkaline Hydrolysis
By: Skvarla, Jiri; Luxbacher, Thomas; Nagy, Martin; et al.
ACS APPLIED MATERIALS & INTERFACES Volume: 2 Issue: 7 Pages: 2116-2127 Published: JUL 2010
Times Cited: 4
(From Web of Science Core Collection)

28. Mechanistic Considerations of Bending-Strain Effects within Organic Semiconductors on Polymer Dielectrics
By: Sokolov, Anatoliy N.; Cao, Yadong; Johnson, Olasupo B.; et al.
ADVANCED FUNCTIONAL MATERIALS Volume: 22 Issue: 1 Pages: 175-183 Published: JAN 11 2012
Times Cited: 25
(From Web of Science Core Collection)

29. Metal-oxide-semiconductor field effect transistor humidity sensor using surface conductance
By: Song, Seok-Ho; Yang, Hyun-Ho; Han, Chang-Hoon; et al.
APPLIED PHYSICS LETTERS Volume: 100 Issue: 10 Article Number: 101603 Published: MAR 5 2012
Times Cited: 5
(From Web of Science Core Collection)

30. Dissolution of cellulose with ionic liquids
By: Swatloski, RP; Spear, SK; Holbrey, JD; et al.
JOURNAL OF THE AMERICAN CHEMICAL SOCIETY Volume: 124 Issue: 18 Pages: 4974-4975 Published: MAY 8 2002
Times Cited: 1,695
(From Web of Science Core Collection)
Relationship of Surface Hydrophilicity, Charge, and Roughness of PET Foils Stimulated by Incipient Alkaline Hydrolysis

By: Skvarla, J (Skvarla, Jiri)[1]; Luxbacher, T (Luxbacher, Thomas); Nagy, M (Nagy, Martin)[1]; Sisol, M (Sisol, Martin)[1]

ACS APPLIED MATERIALS & INTERFACES
Volume: 2 Issue: 7 Pages: 2116-2127
DOI: 10.1021/am100368v
Published: JUL 2010

Abstract
An enhancement of wettability of PET foils pretreated hydrolytically by immersing in mild alkaline (NaOH) solutions has been documented by a descending sigmoidal dependence between the interfacial free energy $\gamma_{SL}$ of the PET/water interface and the concentration of NaOH solution $c_{(NaOH)}$. An increase in temperature of the NaOH solution below the glass-transition temperature of PET further promotes the hydrophilicity, resulting in a proportional shift of the $\gamma_{SL}$ VS $c_{(NaOH)}$ dependence. The limiting hydrophilicity of PET is thermodynamically predicted to occur at $\gamma_{SL} \rightarrow 0$, corresponding to the advancing water contact angle $\theta_{a}$ approximate to 50 degrees (for 6% NaOH and 60 degrees C). The surface roughness due to the partial hydrolytic degradation as well as the weight loss (dissolution) of PET are found to reach a maximum value just when the latter dependence goes through its inflection. Assuming a general parallelism between the interfacial free energy and the dissolution kinetics, we propose the hydrolytically stimulated formation and growth of pits on the PET surface to cause the initial acceleration as well as subsequent retardation of dissolution as $c_{(NaOH)}$, increases, leading to the S-shaped $\gamma_{SL}$ VS $c_{(NaOH)}$ dependence with the inflection for a specific $c_{(NaOH)}$. Moreover, the zeta potential measured by the streaming current method also attains a maximum at the same specific concentration of NaOH. It would indicate that the largest amount of electric charges is populated via polar carboxyl and hydroxyl groups created by chemical scissions of PET polymer chains when a change in the dissolution rate increases to the utmost. In such a way, partial hydrolysis restricted to the uppermost part of moderately hydrophobic surface of solid PET allowed us to better understand the intermingled role of thermodynamic and physical aspects in surface wettability itself.

Keywords
Author Keywords: PET; hydrolysis; wettability; surface roughness; interfacial free energy; contact angle; alkaline degradation; dissolution

KeyWords Plus: SPUN POLY(ETHYLENE-TEREPHTHALATE) FIBERS; MOISTURE-RELATED PROPERTIES; FROTH FLOTATION; POLYVINYL-CHLORIDE; POLYMER SURFACES; CONTACT ANGLES; FREE-ENERGY; ELECTROKINETIC MEASUREMENTS; PVC/PET MIXTURES; FTIR-ATR

Author Information
Reprint Address: Skvarla, J (reprint author)
Tech Univ Kosice, Inst Montaneous Sci & Environm Protect, Ctr Primary & Secondary Raw Mat Proc, Pk Komenskeho 19, Kosice 04384, Slovakia.

Addresses:

E-mail Addresses: jiri.skvarla@tuke.sk

Funding

<table>
<thead>
<tr>
<th>Funding Agency</th>
<th>Grant Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Scientific Grant Agency of the Slovak Republic (VEGA)</td>
<td>2/0159/08</td>
</tr>
</tbody>
</table>

This record is from: Web of Science™ Core Collection

Suggest a correction
If you would like to improve the quality of the data in this record, please suggest a correction.
Electrokinetic Potential for Characterization of Nanosctructured Solid Flat Surfaces

By: Kolska, Z (Kolska, Zdenka) [1]; Kasalkova, NS (Kasalkova, Nikola Slepickova) [2]; Siegel, J (Siegel, Jakub) [2]; Svorcik, V (Svorcik, Vaclav) [2]

JOURNAL OF NANO RESEARCH
Volume: 25 Pages: 31-39
DOI: 10.4028/www.scientific.net/JNanoR.25.31
Published: 2013

Abstract
Electrokinetic potential (zeta potential) is a characteristic parameter for description of the surface chemistry of solid flat materials and it can be used for a fast analysis of materials modified by different chemical or physical methods. Due to its sensitivity, zeta potential is able to distinguish surface modified by coating with monolayers of various materials or nanostructures created after plasma treatment. Also metal nanostructures deposited on surfaces can be characterized by zeta potential. It can also be used for isoelectric point determination of materials. We present data on zeta potential in 0.001 mol/dm(3) KCl at constant pH approximate to 7.0 and also in pH range (2.5-7.0) for isoelectric point determination for pristine polymers PET, PTFE, PS, LDPE, HDPE, PLLA, PVF, PVDF, PMP and polyimides (Uplex R, Upilex S, Kapton). The zeta potential of selected polymers, modified by plasma and by chemical coatings (e.g. by biphenyldithiol or polyethyleneglycol) or by gold deposition was measured too. Zeta potentials of these modified materials were also studied to confirmation that electrokinetic analysis is acceptable method for their fast description.

Keywords
Author Keywords: electrokinetic potential; polymers; surface modification; plasma treatment; gold deposition; cell adhesion and proliferation
KeyWords Plus: CELL-ADHESION; POLYETHYLENE; POLYTETRAFLUOROETHYLENE; PROLIFERATION; POLYMERS; CHARGE

Author Information
Reprint Address: Kolska, Z (reprint author)
Univ JE Purkyne, Fac Sci, Ceske Mladeze 8, Usti Nad Labem 40096, Czech Republic.

Address(es):
[1] Univ JE Purkyne, Fac Sci, Usti Nad Labem 40096, Czech Republic

E-mail Addresses: zdenka.kolska@ujep.cz; nikola.slepickova@vscht.cz; jakub.siegel@vscht.cz; vaclav.svorcik@vscht.cz

Funding

<table>
<thead>
<tr>
<th>Funding Agency</th>
<th>Grant Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grant Agency of Czech Republic</td>
<td>13-06609S P108/10/1106</td>
</tr>
</tbody>
</table>

View funding text

Publisher
TRANS TECH PUBLICATIONS LTD, LAUBISRUTISTR 24, STAFA-ZUERICH, CH-8712, SWITZERLAND

Categories / Classification
Cited References: 20
(from Web of Science Core Collection)

From: Electrokinetic Potential for Characterization of Nanosctructured Solid Fiat Surfaces ...More

1. Modulation of cell adhesion, proliferation and differentiation on materials designed for body implants
   By: Bacakova, Lucie; Filova, Elena; Parizek, Martin; et al.
   BIOTECHNOLOGY ADVANCES Volume: 29 Issue: 6 Pages: 739-767 Published: NOV-DEC 2011
   Find Related Records >
   Times Cited: 85
   (from Web of Science Core Collection)

2. The intrinsic charge on hydrophobic microfluidic substrates
   By: Beattie, James K.
   LAB ON A CHIP Volume: 6 Issue: 11 Pages: 1409-1411 Published: 2006
   Find Related Records >
   Times Cited: 63
   (from Web of Science Core Collection)

3. Cell Adhesion on polytetrafluoroethylene modified by UV-irradiation in an ammonia atmosphere
   By: Heitz, J; Svorcik, V; Bacakova, L; et al.
   JOURNAL OF BIOMEDICAL MATERIALS RESEARCH PART A Volume: 67A Issue: 1 Pages: 130-137 Published: OCT 1 2003
   Find Related Records >
   Times Cited: 40
   (from Web of Science Core Collection)

4. Title: [not available]
   By: Hiemenz, P.C.; Rajagopalan, R.
   Principles of Colloid and Surface Chemistry Published: 1997
   Publisher: Marcel Dekker, New York
   Find Related Records >
   Times Cited: 1,205
   (from Web of Science Core Collection)

5. Cell Adhesion and Proliferation on Plasma-Treated and Poly(ethylene glycol)-Grafted Polyethylene
   By: Kasalkova, N.; Makajova, Z.; Parizek, M.; et al.
   JOURNAL OF ADHESION SCIENCE AND TECHNOLOGY Volume: 24 Issue: 4 Pages: 743-754 Published: 2010
   Find Related Records >
   Times Cited: 19
   (from Web of Science Core Collection)

6. Cell adhesion and proliferation on polyethylene grafted with Au nanoparticles
   By: Kasalkova, N; Slepickova, Slepicka, P.; Kolksa, Z.; et al.
   Conference: 17th International Conference on Ion Beam Modification of Materials (IBMM) Location: Montreal, CANADA
   Date: AUG 22-27, 2010
   NUCLEAR INSTRUMENTS & METHODS IN PHYSICS RESEARCH SECTION B-BEAM INTERACTIONS WITH MATERIALS AND ATOMS Volume: 272 Pages: 391-395 Published: FEB 1 2012
   Find Related Records >
   Times Cited: 6
   (from Web of Science Core Collection)

7. Zeta potential of microfluidic substrates: 1. Theory, experimental techniques, and effects on separations
   By: Kirby, BJ; Hasselbrink, EF
   ELECTROPHORESIS Volume: 25 Issue: 2 Pages: 187-202 Published: JAN 2004
   Find Related Records >
   Times Cited: 363
   (from Web of Science Core Collection)

8. Surface characterization of polymer foils
   By: Kolksa, Z.; Reznickova, A.; Svorcik, V.
   E-Polymers Volume: 83 Pages: 1-13 Published: 2012
   Find Related Records >
   Times Cited: 10
   (from Web of Science Core Collection)

9. Zeta potential determination of flat solid surfaces using a SurPASS electrokinetic analyzer
   By: Luxbacher, Thomas; Buksek, Hermia; Petrinic, Irena; et al.
   TEKSTIL Volume: 58 Issue: 8 Pages: 393-400 Published: AUG 2009
   Find Related Records >
   Times Cited: 3
   (from Web of Science Core Collection)

10. Cell microarrays on photochemically modified polytetrafluoroethylene
   Times Cited: 51

Web of Science [v.5.15] - Web of Science Core Collection Cited References
http://apps.webofknowledge.com/InterService.do?product=WOS&tx...
Relationship of Surface Hydrophilicity, Charge, and Roughness of PET Foils Stimulated by Incipient Alkaline Hydrolysis

By: Skvarla, J (Skvarla, Jiri)
Luxbacher, T (Luxbacher, Thomas); Nagy, M (Nagy, Martin)
Sisol, M (Sisol, Martin)

ACS APPLIED MATERIALS & INTERFACES
Volume: 2 Issue: 7 Pages: 2116-2127
DOI: 10.1021/am100368v
Published: JUL 2010

Abstract
An enhancement of wettability of PET foils pretreated hydrolytically by immersing in mild alkaline (NaOH) solutions has been documented by a descending sigmoidal dependence between the interfacial free energy \( \gamma(SL) \) of the PET/water interface and the concentration of NaOH solution \( c(NaOH) \). An increase in temperature of the NaOH solution below the glass-transition temperature of PET further promotes the hydrophilicity, resulting in a proportional shift of the \( \gamma(SL) \) VS \( c(NaOH) \) dependence. The limiting hydrophilicity of PET is thermodynamically predicted to occur at \( \gamma(SL) \to 0 \), corresponding to the advancing water contact angle \( \theta(a) \approx 50^\circ \) (for 6% NaOH and 60 degrees C). The surface roughness due to the partial hydrolytic degradation as well as the weight loss (dissolution) of PET are found to reach a maximum value just when the latter dependence goes through its inflection. Assuming a general parallelism between the interfacial free energy and the dissolution kinetics, we propose the hydrolytically stimulated formation and growth of pits on the PET surface to cause the initial acceleration as well as subsequent retardation of dissolution as \( c(NaOH) \), increases, leading to the S-shaped \( \gamma(SL) \) VS \( c(NaOH) \) dependence with the inflection for a specific \( c(NaOH) \). Moreover, the zeta potential measured by the streaming current method also attains a maximum at the same specific concentration of NaOH. It would indicate that the largest amount of electric charges is populated via polar carboxyl and hydroxyl groups created by chemical scissions of PET polymer chains when a change in the dissolution rate increases to the utmost. In such a way, partial hydrolysis restricted to the uppermost part of moderately hydrophobic surface of solid PET allowed us to better understand the intermingled role of thermodynamic and physical aspects in surface wettability itself.

Keywords

Author Keywords: PET; hydrolysis; wettability; surface roughness; interfacial free energy; contact angle; alkaline degradation; dissolution

KeyWords Plus: SPUN POLY(ETHYLENE-TerePHthalATE) FIBERS; MOISTURE-RELATED PROPERTIES; FROTH FLOTATION; POLYVINYL-CHLORIDE; POLYMER SURFACES; CONTACT ANGLES; FREE-ENERGY; ELECTROKINETIC MEASUREMENTS; PVC/PET MIXTURES; FTIR-ATR

Author Information

Reprint Address: Skvarla, J (reprint author)
Tech Univ Kosice, Inst Montaneous Sci & Environm Protect, Ctr Primary & Secondary Raw Mat Proc, Pk Komenskeho 19, Kosice 04384, Slovakia.

Addresses:

E-mail Addresses: jiri.skvarla@tuke.sk

Funding

<table>
<thead>
<tr>
<th>Funding Agency</th>
<th>Grant Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Scientific Grant Agency of the Slovak Republic (VEGA)</td>
<td>2/0159/08</td>
</tr>
</tbody>
</table>
Impinging jet study of the deposition of colloidal particles on modified polycarbonate and poly(ethylene terephthalate) surfaces

By: Lapcik, L (Lapcik, Lubomir, Jr)[1]; Frastik, M (Frastik, Michal)[1]; Lapcikova, B (Lapcikova, Barbora)[1]

INTERNATIONAL JOURNAL OF HEAT AND MASS TRANSFER
Volume: 55 Issue: 5-6 Pages: 1513-1518
DOI: 10.1016/j.ijheatmasstransfer.2011.11.002
Published: FEB 2012
View Journal Information

Abstract
Main focus of this study was on characterization of surface properties of virgin and 1,2-dipalmitoyl-sn-glycero-3-phosphocholine (DPPC) phospholipid layer coated poly(ethylene terephthalate) (PET) and polycarbonate (PC) planar articles. Surface properties were followed measuring static contact angles of wetting by means of sessile drop method and deposition of negative polystyrene (PS) colloidal particles followed by impinging jet method at defined flow regimes. It was found that phospholipid coating of both studied samples (PET, PC) led to the vigorous increase of the surface free energy. For coated samples major part of the surface free energy was dominated by polar component in contrast to the non-treated materials. Here the dispersive component was dominating. Results of the deposition experiments of polystyrene particles of 3 μm diameter correspond with trends obtained by contact angle measurements, i.e. the surface treated materials exhibited higher surface activity reflected in increased particle deposition rates. Simultaneously there was confirmed the fact, that with increasing magnitude of the Reynolds number of the dispersion flux the higher deposition rates were observed. (C) 2011 Elsevier Ltd. All rights reserved.

Keywords
Author Keywords: Contact angles of wetting; Impinging jet; Poly(ethylene terephthalate); Polycarbonate; Phospholipid layer; Polystyrene particles; Deposition kinetics
KeyWords Plus: HYALURONIC-ACID; SOLID-SURFACES; KINETICS; ADSORPTION; WALL

Author Information
Reprint Address: Lapcik, L (reprint author)
Tomas Bata Univ Zlin, Fac Technol, Ctr Polymer Syst, Nam TG Masaryka 5555, Zlin 76005, Czech Republic.

Addresses:
[1] Tomas Bata Univ Zlin, Fac Technol, Ctr Polymer Syst, Nam TG Masaryka 5555, Zlin 76005, Czech Republic

E-mail Addresses: lapcik@ft.utb.cz

Author Identifiers:

Funding

<table>
<thead>
<tr>
<th>Funding Agency</th>
<th>Grant Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operational Program Research and Development for Innovations</td>
<td></td>
</tr>
<tr>
<td>European Regional Development Fund (ERDF)</td>
<td></td>
</tr>
<tr>
<td>national budget of Czech Republic</td>
<td>CZ.1.05/2.1.00/03.0111</td>
</tr>
</tbody>
</table>

View funding text

Publisher
PERGAMON-ELSEVIER SCIENCE LTD, THE BOULEVARD, LANGFORD LANE, KIDLINGTON,
Cited References: 26
(from Web of Science Core Collection)

From: Impinging jet study of the deposition of colloidal particles on modified polycarbonate and poly(ethyl...More

1. Role of convection in particle deposition at solid surfaces
   By: Adamczyk, Z; Warszynski, P; Szyk-Warszynska, L; et al.
   Times Cited: 25
   (from Web of Science Core Collection)

2. Kinetics of particle deposition in the radial impinging-jet cell
   By: Adamczyk, Z; Siwek, B; Warszynski, P; et al.
   JOURNAL OF COLLOID AND INTERFACE SCIENCE Volume: 242 Issue: 1 Pages: 14-24 Published: OCT 1 2001
   Times Cited: 42
   (from Web of Science Core Collection)

3. KINETICS OF LOCALIZED ADSORPTION OF COLLOID PARTICLES
   By: ADAMCZYK, Z; SIWEK, B; ZEMBALA, M; et al.
   LANGMUIR Volume: 8 Issue: 11 Pages: 2605-2610 Published: NOV 1992
   Times Cited: 34
   (from Web of Science Core Collection)

4. Particles at Interfaces: Interactions, Deposition, Structure
   By: Adamczyk, Z
   Publisher: ELSEVIER ACADEMIC PRESS INC, 525 B STREET, SUITE 1900, SAN DIEGO, CA 92101-4495 USA
   Times Cited: 58
   (from Web of Science Core Collection)

5. MAGNETIC-FIELD AND TEMPERATURE EFFECTS ON THE SOLID-STATE PROTON SPIN-LATTICE RELAXATION-TIME MEASUREMENTS OF WOOD AND PULPS
   By: ARGYROPOULOS, DS; MORIN, FG; LAPCIK, L
   HOLZFORSCHUNG Volume: 49 Issue: 2 Pages: 115-118 Published: 1995
   Times Cited: 6
   (from Web of Science Core Collection)

6. A DIRECT METHOD FOR STUDYING PARTICLE DEPOSITION ONTO SOLID-SURFACES
   By: DABROS, T; VANDEVEN, TGM
   COLLOID AND POLYMER SCIENCE Volume: 261 Issue: 8 Pages: 694-707 Published: 1983
   Times Cited: 249
   (from Web of Science Core Collection)

7. KINETICS OF COATING BY COLLOIDAL PARTICLES
   By: DABROS, T; VANDEVEN, TGM
   JOURNAL OF COLLOID AND INTERFACE SCIENCE Volume: 89 Issue: 1 Pages: 232-244 Published: 1982
   Times Cited: 119
   (from Web of Science Core Collection)

8. SLOW VISCOUS MOTION OF A SPHERE PARALLEL TO A PLANE WALL .2. COUETTE FLOW
   By: Goldman, AJ; Cox, RG; Brenner, H
   CHEMICAL ENGINEERING SCIENCE Volume: 22 Issue: 4 Pages: 653-668 Abstract Number: A1968-07866 Published: 1967
   Times Cited: 736
   (from Web of Science Core Collection)

9. Zeta potential and surface free energy changes of solid-supported phospholipid (DPPC) layers caused by the enzyme phospholipase A(2) (PLA(2))
   By: Jurak, Małgorzata; Chibowski, Emil
   ADSORPTION-JOURNAL OF THE INTERNATIONAL ADSORPTION SOCIETY Volume: 15 Issue: 2 Pages: 211-219 Published: APR 2009
   Times Cited: 9
   (from Web of Science Core Collection)
<table>
<thead>
<tr>
<th>ID</th>
<th>Title</th>
<th>By:</th>
<th>Journal/Conference Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>23</td>
<td>Characterizing polymers with an impinging jet</td>
<td>vandeVen, TGM; Kelemen, SJ</td>
<td>Journal of Colloid and Interface Science Volume: 181, Issue: 1, Pages: 118-123, Published: JUL 15 1996</td>
</tr>
<tr>
<td>24</td>
<td>COLLOIDAL PARTICLE SCATTERING - A NEW METHOD TO MEASURE SURFACE FORCES</td>
<td>VANDEVEN, TGM; WARSZYNSKI, P; WU, X et al.</td>
<td>Langmuir Volume: 10, Issue: 9, Pages: 3046-3056, Published: SEP 1994</td>
</tr>
<tr>
<td>25</td>
<td>Coupling of hydrodynamic and electric interactions in adsorption of colloidal particles</td>
<td>Warszynski, P</td>
<td>Advances in Colloid and Interface Science Volume: 84, Issue: 1-3, Pages: 47-142, Published: JAN 1 2000</td>
</tr>
<tr>
<td>26</td>
<td>Electrokinetic lift force for a charged particle moving near a charged wall - a modified theory and experiment</td>
<td>Warszynski, P; Wu, X; van de Ven, TGM</td>
<td>Colloids and Surfaces A: Physicochemical and Engineering Aspects Volume: 140, Issue: 1-3, Pages: 183-198, Published: SEP 30 1998</td>
</tr>
</tbody>
</table>
Relationship of Surface Hydrophilicity, Charge, and Roughness of PET Foils Stimulated by Incipient Alkaline Hydrolysis

By: Skvarla, J (Skvarla, Jiri)¹; Luxbacher, T (Luxbacher, Thomas); Nagy, M (Nagy, Martin)¹; Sisol, M (Sisol, Martin)¹

ACS APPLIED MATERIALS & INTERFACES
Volume: 2 Issue: 7 Pages: 2116-2127
DOI: 10.1021/am100368v
Published: JUL 2010

Abstract
An enhancement of wettability of PET foils pretreated hydrolytically by immersing in mild alkaline (NaOH) solutions has been documented by a descending sigmoidal dependence between the interfacial free energy \( \gamma(SL) \) of the PET/water interface and the concentration of NaOH solution \( c(\text{NaOH}) \). An increase in temperature of the NaOH solution below the glass-transition temperature of PET further promotes the hydrophilicity, resulting in a proportional shift of the \( \gamma(SL) \text{ VS } c(\text{NaOH}) \) dependence. The limiting hydrophilicity of PET is thermodynamically predicted to occur at \( \gamma(SL) \approx 0 \), corresponding to the advancing water contact angle \( \theta(a) \approx 50^\circ \) (for 6% NaOH and 60 degrees C). The surface roughness due to the partial hydrolytic degradation as well as the weight loss (dissolution) of PET are found to reach a maximum value just when the latter dependence goes through its inflection. Assuming a general parallelism between the interfacial free energy and the dissolution kinetics, we propose the hydrolytically stimulated formation and growth of pits on the PET surface to cause the initial acceleration as well as subsequent retardation of dissolution as \( c(\text{NaOH}) \) increases, leading to the S-shaped \( \gamma(SL) \text{ VS } c(\text{NaOH}) \) dependence with the inflection for a specific concentration of NaOH. Moreover, the zeta potential measured by the streaming current method also attains a maximum at the same specific concentration of NaOH. It would indicate that the largest amount of electric charges is populated via polar carboxyl and hydroxyl groups created by chemical scissions of PET polymer chains when a change in the dissolution rate increases to the utmost. In such a way, partial hydrolysis restricted to the uppermost part of moderately hydrophobic surface of solid PET allowed us to better understand the intermingled role of thermodynamic and physical aspects in surface wettability itself.

Keywords

Author Keywords: PET; hydrolysis; wettability; surface roughness; interfacial free energy; contact angle; alkaline degradation; dissolution

KeyWords Plus: SPUN POLY(ETHYLENE-TEREPHTHALATE) FIBERS; MOISTURE-RELATED PROPERTIES; FROTH FLOTATION; POLYVINYL-CHLORIDE; POLYMER SURFACES; CONTACT ANGLES; FREE-ENERGY; ELECTROKINETIC MEASUREMENTS; PVC/PET MIXTURES; FTIR-ATR

Author Information

Reprint Address: Skvarla, J (reprint author)
Tech Univ Kosice, Inst Montaneous Sci & Environm Protect, Ctr Primary & Secondary Raw Mat Proc, Pk Komenskeho 19, Kosice 04384, Slovakia.

Addresses:

[¹] Tech Univ Kosice, Inst Montaneous Sci & Environm Protect, Ctr Primary & Secondary Raw Mat Proc, Kosice 04384, Slovakia

E-mail Addresses: jiri.skvarla@tuke.sk

Funding

<table>
<thead>
<tr>
<th>Funding Agency</th>
<th>Grant Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Scientific Grant Agency of the Slovak Republic (VEGA)</td>
<td>2/0159/08</td>
</tr>
</tbody>
</table>