Innovative Barrier Film generated by Advanced Clear Coating Technologies
Ⅰ. DNP Introduction

Ⅱ. IB (Innovative Barrier) Film feature
DNP Introduction
Established: 1876
HQ Location: Tokyo, JAPAN
Capital (as of March 2010): ¥ 115 billion
Annual Sales (as of March 2010):
- ¥ 1,580 billion (Consolidated)
- ¥ 1,090 billion (Non-Consolidated)
Number of Employees (as of March 2010):
- 39,643 (Consolidated)
- 10,539 (Non-Consolidated)
Operations:
- Information Communication
- Lifestyle & Industrial Supplies (incl. Packaging)
- Electronics
Information Communication

- Books and Magazines
  Books, Magazines, Dictionaries
  Textbooks, Graphic collections
  e-books

- Commercial Printing
  Catalogs, Calendars, Posters
  Promotional Publication

- Information Processing Services
  Personal mail, Business forms
  Credit/Banking cards, SIM cards
  Hologram
Lifestyle and Industrial Supplies

- Packaging
  Foods, Beverages, Personal care, Home care, Pharmaceuticals

- Decorative materials
  Interior and Exterior decorative material for houses, buildings

- Optical material, Industrial material
  Optical film for Display, Projector screen
  Sublimation/Thermal transfer ribbon
  Self print system
Electronics

- Displays
  Color-filter for LCD
  Organic light emitting display

- Electronic Components
  Photo-mask and Lead flame
  for Semi-conductors products
  IC-Tag, MEMS
IB (Innovative Barrier) Film feature

(Passive Barrier)
IB-Film Functions & Added-Values

IB-Film offers Functions and added-values to package

Functions

- Excellent Gas Barrier
- Sterilizability
- Direct Printability
- Transparency

Added-Values

- Microwave-ability
- Easy Converting
- Source Reduction
- Eco-Friendly
IB-FILMs are classified into 3 subfamilies depending on deposition methods and substrates:

- **CVD**: Chemical Vapor Deposition
- **PVD**: Physical Vapor Deposition

**Deposition** (CVD, PVD) — **Layer** (SiO$_x$, AlO$_x$) — **Substrate** (OPA-PET, IB-ON, IB-PET, IB-PET-P)

- IB-ON
- IB-PET
- IB-PET-P
CVD technology enables to produce carbon containing SiOx onto substrate, giving the following beneficial characteristics:

- Highly flexible deposition layer
- Durable against physical and thermal stresses
- Colorless and clear
- Good bonding strength with substrate
- Processable on poor heat resistance substrates
Physical Vapor Deposition Process (PVD)

PVD technology enables to produce AlOx onto substrate, giving the following beneficial characteristics:

- Colorless and high transparency
- Large volume manufacturing
- Stability of manufactured
## Converting & Process-ability Profile

<table>
<thead>
<tr>
<th>Converting &amp; Processing</th>
<th>IB-ON -UB</th>
<th>IB-PET -UB</th>
<th>IB-PET -PIR</th>
<th>IB-PET -PXB</th>
</tr>
</thead>
<tbody>
<tr>
<td>Direct Printing (Roto gravia)</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>△</td>
</tr>
<tr>
<td>Solvent-Base Adhesive Laminate (approved by FDA)</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Extrusion Lamination</td>
<td>○ 300°C 20 μm</td>
<td>○ 320°C 20 μm</td>
<td>○ 300°C 15 μm</td>
<td>×</td>
</tr>
<tr>
<td>-Limit melt temperature or PE</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>-Limit extrudable PE thickness</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Boil Treatment</td>
<td>○ 95°C</td>
<td>○ 95°C</td>
<td>○ 95°C</td>
<td>×</td>
</tr>
<tr>
<td>Retort Treatment</td>
<td>×</td>
<td>×</td>
<td>○ 135°C</td>
<td>×</td>
</tr>
</tbody>
</table>

* ○: Good  △: Poor  ×: Bad or not recommendable
### IB-Film line up & applications

<table>
<thead>
<tr>
<th>IB Subfamily</th>
<th>IB Grade</th>
<th>μm</th>
<th>OXTR</th>
<th>WVTR</th>
<th>Laminate Structure</th>
<th>Typical Applications</th>
</tr>
</thead>
<tbody>
<tr>
<td>IB-ON</td>
<td>BOPA</td>
<td>15</td>
<td>0.3</td>
<td>1.8</td>
<td>2-Layer</td>
<td>Boilable sachet</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Flavored sauce bag</td>
</tr>
<tr>
<td>IB-PET</td>
<td>IB-PET-UB</td>
<td>12</td>
<td>0.3</td>
<td>0.8</td>
<td>2-Layer</td>
<td>Laminate Tube</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Paperboard Carton</td>
</tr>
<tr>
<td>IB-PET-P</td>
<td>IB-PET-PIR</td>
<td>12</td>
<td>0.2</td>
<td>0.5</td>
<td>3-Layer</td>
<td>Retort</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Medical / Infusion Bag</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Dry Foods, Confectionary</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Industrial Supplies</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Water-sensitive product</td>
</tr>
<tr>
<td>IB-PET-P</td>
<td>IB-PET-PXB</td>
<td>12</td>
<td>0.1</td>
<td>0.1</td>
<td>2-Layer</td>
<td>Industrial Supplies</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Water-sensitive product</td>
</tr>
</tbody>
</table>

**OXTR** : cc/m²/day/atm (23°C/90%RH)  
**WVTR** : g/m²/day (40°C/90%RH)

※These data are based on measurement, but not guaranteed.
• General Performance – *High temperature boil sterilization*

<table>
<thead>
<tr>
<th></th>
<th>Before Boil</th>
<th>After Boil</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>OXTR</td>
<td>WVTR</td>
</tr>
<tr>
<td>IB-ON-UB</td>
<td>0.3</td>
<td>1.8</td>
</tr>
<tr>
<td>(competitive) ON/SiOx(PVD)</td>
<td>0.4</td>
<td>0.5</td>
</tr>
</tbody>
</table>

“95°C × 30min”

Structure: Base-ON15/adhesive/PE60
OXTR: 23°C/90%RH
WVTR: 40°C/90%RH

• Characteristics and promising applications

- Good gelbo-flex durability
- Good flavor barrier
- Extrusion coating is available
- Direct printable
- Microwave-able
- Applications
  - Sachet
  - Cup noodle packaging

Sensory test for flavor retention (40°C/7days)
• General Performance - Low Dependency on Temp. and Humidity

<table>
<thead>
<tr>
<th>Temp./Humidity</th>
<th>OXTR</th>
<th>WVTR</th>
</tr>
</thead>
<tbody>
<tr>
<td>IB-PET-UB 23°C/90%RH</td>
<td>0.3</td>
<td>0.2</td>
</tr>
<tr>
<td>IB-PET-UB 30°C/90%RH</td>
<td>0.4</td>
<td>0.4</td>
</tr>
<tr>
<td>IB-PET-UB 40°C/90%RH</td>
<td>0.5</td>
<td>0.8</td>
</tr>
</tbody>
</table>

Structure: IB-PET-UB12/adhesive/PE60

• Characteristics and promising applications

- Suitable for liquid packaging
- Good gelbo-flex durability
- Extrusion coating is available
- Direct printable
- Microwave-able

Applications
- Laminate Tube
- Paperboard Carton
- Wet-tissue pillow pouch
• General Performance - Low Dependency on Temp. and Humidity

<table>
<thead>
<tr>
<th>Temp./Humidity</th>
<th>OXTR</th>
<th>WVTR</th>
</tr>
</thead>
<tbody>
<tr>
<td>IB-PET-PUB</td>
<td>0.3</td>
<td>0.1</td>
</tr>
<tr>
<td>23°C/90%RH</td>
<td></td>
<td></td>
</tr>
<tr>
<td>30°C/90%RH</td>
<td>0.3</td>
<td>0.2</td>
</tr>
<tr>
<td>40°C/90%RH</td>
<td>0.4</td>
<td>0.5</td>
</tr>
</tbody>
</table>

Structure: IB-PET-PUB12/adhesive/PE60

• Characteristics and promising applications

- Suitable for dry food packaging
- Excellent moisture barrier
- Extrusion coating is available
- Direct printable
- Microwave-able

Applications:
- Dry foods
- Water sensitive articles

![Graph showing weight change over time at different humidity levels (90%, 75%, 50% RH)](chart)

- Temp. = 40°C constant
- Pouch size: 100mm × 100m
- Content: Calcium chloride
**General Performance - Ultra High Moisture Barrier**

<table>
<thead>
<tr>
<th>Layer</th>
<th>OXTR (ºC/90%RH)</th>
<th>WVTR (ºC/90%RH)</th>
</tr>
</thead>
<tbody>
<tr>
<td>IB-PET-PXB Single Layer</td>
<td>0.1</td>
<td>0.1</td>
</tr>
</tbody>
</table>

**Characteristics and promising applications**

- Suitable for water sensitive articles
- Excellent moisture barrier
- Direct printable
- Microwave-able
- Applications
  - Mouth freshener
  - Silicon wafer
  - Vacuum infusion bag
  - Price tag

**Graph:**

- Title: Weight Change (g/package) vs. Time Intervals (Days)
- Data points:
  - PUB Single
  - PXB Single
  - PXB Double

**Legend:**

- Pouch size: 100mm × 100m
- Content: Calcium chloride
New grade “IB-PET-PIR” for retort
**Feature of “IB-PET-PIR”**

- **IB-PET-PIR** consists of AlOx layer using PVD method and wet coating layer on the PET substrate.
- **IB-PET-PIR** has many characteristics which are **retort treatment resistance** and **high barrier properties**.

↓ Colorless and High transparency
↓ Large volume manufacturing

You can use following example!

- Retort Pouch & Lid
- Boil Pouch & Bag
- Packaging for microwave
- Medical Bag
### IB-PET-PIR Barrier Property

**General Performance - Well-balanced gas barrier suitable for retort**

<table>
<thead>
<tr>
<th></th>
<th>Before Retort</th>
<th>After Retort</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>OXTR</td>
<td>WVTR</td>
</tr>
<tr>
<td><strong>“121°C × 30min”</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>IB-PET-PIR</td>
<td>0.2</td>
<td>0.5</td>
</tr>
<tr>
<td>(competitive) PET/AlOx</td>
<td>0.3</td>
<td>0.5</td>
</tr>
<tr>
<td>Structure: Base-PET12/adh/ON15/adh/CPP70 (3-Layer)</td>
<td>OXTR (cc/m²·day·atm): 23°C/90%RH</td>
<td>WVTR (g/m²·day): 40°C/90%RH</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>Before Retort</th>
<th>After Retort</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>OXTR</td>
<td>WVTR</td>
</tr>
<tr>
<td><strong>“135°C × 30min”</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>IB-PET-PIR</td>
<td>0.2</td>
<td>0.5</td>
</tr>
<tr>
<td>(competitive) PET/AlOx</td>
<td>0.3</td>
<td>0.5</td>
</tr>
<tr>
<td>Structure: Base-PET12/adh/ON15/adh/CPP70 (3-Layer)</td>
<td>OXTR (cc/m²·day·atm): 23°C/90%RH</td>
<td>WVTR (g/m²·day): 40°C/90%RH</td>
</tr>
</tbody>
</table>

※These data are based on measurement, but not guaranteed.
Anti-Elongation Property

- Oxygen barrier property after elongation to specific point

![Graph showing elongation property for different samples.]

Competitor A: SiOx (P)
Competitor B: AlOx (P)
Competitor C: AlOx (P)
PIR (P) (P): PVD

VM-PET12 (Retort grade)/Ad/ON15/Ad/CPP70
Gelbo-Flex Test

Twisting and Compress

ASTM F392

Oxygen barrier

Competitor A
SiOx(P)

Competitor B
AlOx(P)

Competitor C
AlOx(P)

PIR(P)
(P): PVD

VM-PET12 (Retort grade)/Ad/ON15/Ad/CPP70
Retort Temp. and Durability

Retort condition: 30 min
Layer structure: VM-PET12 (Retort grade)/Ad/ON15/Ad/CPP70

OXTR

WVTR

IB-PET-PIR keeps a good barrier properties until 135°C retort treatment conditions.
# IB-Film Compliance Status EU & FDA

<table>
<thead>
<tr>
<th>IB Subfamily</th>
<th>IB Grades</th>
<th>EU Regulations*</th>
<th>FDA Regulations</th>
</tr>
</thead>
<tbody>
<tr>
<td>IB-ON</td>
<td>IB-ON-UB</td>
<td>Complies</td>
<td>Complies</td>
</tr>
<tr>
<td>IB-PET</td>
<td>IB-PET-UB</td>
<td>Complies</td>
<td>Complies</td>
</tr>
<tr>
<td></td>
<td>IB-PET-RB</td>
<td>Complies</td>
<td>Complies</td>
</tr>
<tr>
<td></td>
<td>IB-PET-PUB</td>
<td>Complies</td>
<td>Complies</td>
</tr>
<tr>
<td></td>
<td>IB-PET-PXB</td>
<td>under investigation</td>
<td>Complies</td>
</tr>
<tr>
<td>IB-PET-P-P</td>
<td>IB-PET-PIR</td>
<td>under investigation</td>
<td>Complies</td>
</tr>
</tbody>
</table>

* Brand-new grade

- German Food Contact Regulation
- Switzerland Food Contact Regulation
- Italian Food Contact Regulation
Typical applications 2

(PET substrate)

Confectionery

Retort food

Pasteurized rice

Beverage

General foods

Industrial supplies

DNP

© 2011 Dai Nippon Printing Co., Ltd. All Rights Reserved.
Pharmaceutical / Medical Application: Moisture Barrier (IB-PET-PIR, IB-PET-PXB)

- Tablet outer packaging
- Eye drop outer packaging
- Ampoule outer packaging
- Cylinder outer packaging
- Healthcare product packaging (Wet tissue)
- Breath care
- Bath salts

Pharmaceutical / Medical Application: Heat resistance Barrier (IB-PET-PIR)

- Nutritional outer packaging
- Infusion bag
- Pharmaceutical cup lids
- Retort laminated tube
Non Food Application 2

Industrial Material Application: Moisture Barrier (IB-PET-PIR, IB-PET-PXB)

- Ink toner container
- Ink cartridge
- Insulation material
- Flexible display
- Touch panel
- Electric material packaging
- Replacement for thin glass
- E-book
- E-tag
- Inner bag for industrial paper bag
Thank you for your attention.