

# Freshure<sup>®</sup> Coatings: INNOVATION IN CLEAR BARRIER COATINGS

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Pure Knowledge

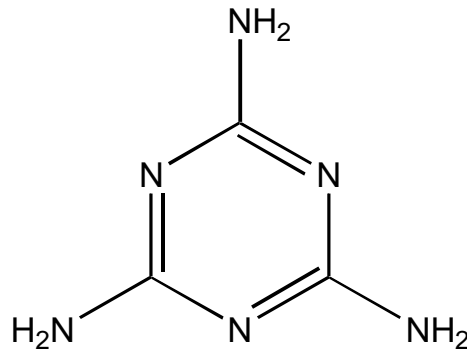
- Background
- SymPhase<sup>®</sup> Technology
- Freshure<sup>®</sup> Coatings
  - Freshure<sup>®</sup>-*Single Coat*: Functional Clear Barrier Coatings
  - Freshure<sup>®</sup>-*Top Coat*: In-line Protection of Vacuum Coated Packaging Films
- Value Proposition
- Business Model
- Conclusion

- Freshure<sup>®</sup> Coatings are produced by SymPhase<sup>®</sup>, a patented technology by Royal DSM, now available for licensing.
- The presentation outlines the use of Freshure<sup>®</sup> Coatings in flexible packaging as:
  1. A single functional layer to produce high gas barrier transparent coatings (Freshure<sup>®</sup>-*Single Coat*)
  2. An in-line top coat to protect vacuum coated layers and improve performance (Freshure<sup>®</sup>-*Top Coat*)

# SymPhase<sup>®</sup>: A Patented Vapor Deposition Technology

3

- SymPhase<sup>®</sup> Technology is based on the vapor deposition of melamine:

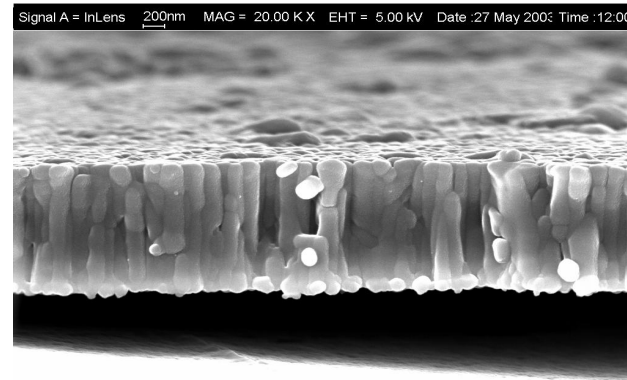
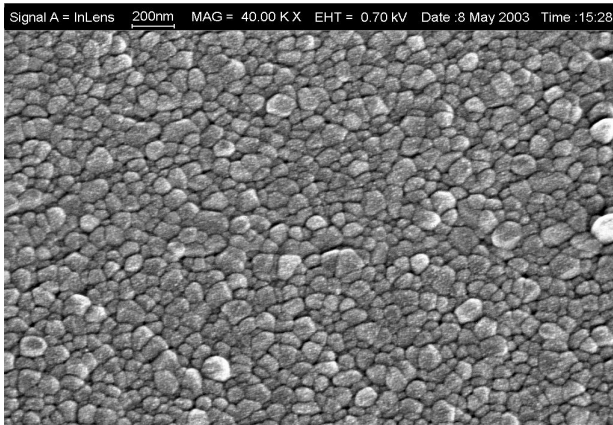


- Basic application: as an ingredient in adhesives for production of e.g. laminates and wood panels (annual WW production ~1,000 kt).
- DSM market share: world leader (30% market share).
- Price range: around 1 euro per kg.
- Safety: FDA approved (direct food contact) and biodegradable.
- Physical characteristics: sublimation > 200°C and melting/degradation point > 350°C.

# SymPhase<sup>®</sup> Technology: Typical Conditions to Produce Freshure<sup>®</sup> Coatings

4

- SymPhase<sup>®</sup> Technology is a Physical Vapor Deposition (PVD) process.
- Typically melamine vapor deposition occurs at relatively soft conditions; T~300°C and Pressure~ 10<sup>-2</sup> mbar.
- At speeds higher than 10 m/s, melamine is coated in a roll-to-roll process on various polymeric substrates (BOPP, PET, PLA etc):



- Due to hydrogen bonding interactions, melamine covers large surface areas in a fraction of second creating a nanolayer (<100 nm) of transparent crystalline coating.

- **An existing vacuum metallizer has been successfully retrofitted with a melamine evaporator.**
- **A brand new vacuum coater has recently been commissioned, equipped with a 1.6 meter wide melamine evaporator.**
- **This line is expected to be commercial by end of 2007.**

- SymPhase<sup>®</sup> is a “soft” deposition process:
  - No need for expensive cooling and pumping systems.
  - Shorter cycle times as the pump down-times and cooling periods will be considerably shorter.
  - Possibility of coating temperature-sensitive polymers such as PE.
  - For Al metallization special grade BOPP films are needed to withstand the high temperature. For melamine more conventional polymer films may be used.
- In principle an existing vacuum coater can be retrofitted with melamine evaporator.
- The “Cost of Ownership” (CoO) is lower than the standard vacuum coating/metallization process:
  - Relatively low investment.
  - High coating speeds and uptimes.
  - Low cost of source material, i.e. melamine

- Freshure<sup>®</sup> Coatings
  - Freshure<sup>®</sup>-*Single Coat*. Functional Clear Barrier Coatings
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Freshure<sup>®</sup>-*Single Coat*. Functional Clear Barrier Coatings

- Application of a nanolayer of Freshure<sup>®</sup>-Coatings on various polymeric substrates creates transparent high gas barrier coatings:

Substrate	OTR [cc/m <sup>2</sup> /day, 23°C/0% RH]
BOPP (20 μm)	1600
BOPP/ Freshure <sup>®</sup> -Single Coat	< 20
PET (12 μm)	110
PET/ Freshure <sup>®</sup> -Single Coat	~ 1
PLA (20 μm)	800
PLA/ Freshure <sup>®</sup> -Single Coat	< 40

- Oxygen barrier values of Freshure<sup>®</sup>-Single Coat are comparable, and sometime even better, than other vacuum processed coatings (Al, AlO<sub>x</sub>, SiO<sub>x</sub>) and alternative barrier technologies (PVdC, EVOH etc.)

- In principle it is possible to maintain the high oxygen barrier at high humidities (> 85%) and temperature (> 40°C):

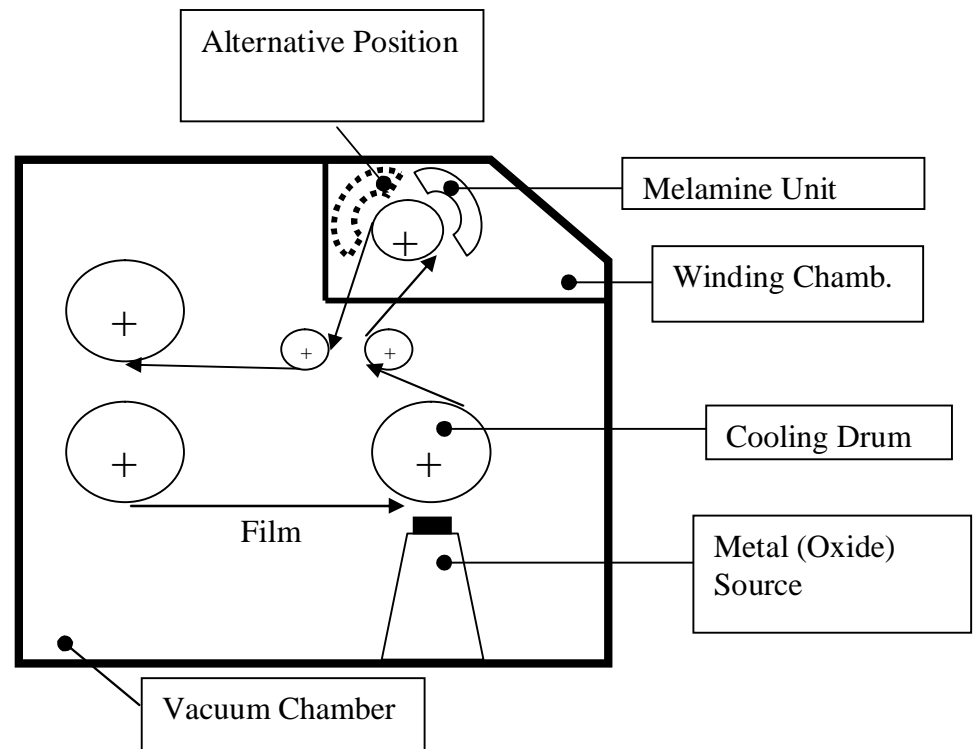
Sample	OTR (cc/m <sup>2</sup> *day)		
	0% RH	85% RH (23°C)	85% RH (40°C)
PET/ Freshure <sup>®</sup> -Single Coat 1	2.1	2.6	1.9
PET/ Freshure <sup>®</sup> -Single Coat 2	1.2	1.3	1.1
PET/ Freshure <sup>®</sup> -Single Coat 3	0.5	1.5	-

- Note: Freshure<sup>®</sup>-Single Coat is currently not suitable for use under retorting conditions, but further work is in progress to achieve this target.

- High oxygen barrier
- Applicable to temperature-sensitive polymers
- Ease of production
- Convertible under standard lamination conditions
- Transparent
- Flexible
- Microwaveable
- Cost competitive
- FDA approved – direct food contact
- Environmentally friendly - biodegradable

Freshure®-*Top Coat*. In-line Protection of Vacuum Coated Packaging Films

- The Freshure<sup>®</sup>-Top Coat application has been developed for the production of in-line coating to protect vacuum deposited aluminum or oxide coatings on packaging films.
- For this application, the evaporator is placed after the oxide coating or metallizing unit so that the oxide coated/metallized film is top coated with Freshure<sup>®</sup>-Coating in one machine pass.



**A Typical Set Up for Freshure<sup>®</sup>-Top Coat Application!!**

- **HIGHER BARRIER**

- Freshure<sup>®</sup>-Top Coat provides “active” protection of the oxide coated/metallized layer, resulting in improved barrier performance, at three levels:
  - In the vacuum chamber
  - During conversion
  - In food packaging
- Magnitude of barrier improved depends on the substrate, but a factor of X2 improvement is achievable.

- **SURFACE TENSION OF COATING**

- Surface tension (ST) of standard metallized films usually drops from ~50 to below 37 dyne/cm within 60 days after metallization. With Freshure<sup>®</sup>-Top coat, however, ST remains above 50 dyne/cm for 6-12 months. The potential advantages are:
  - No need for in-line corona treatment before conversion
  - Lamination speed increased by at least 30%

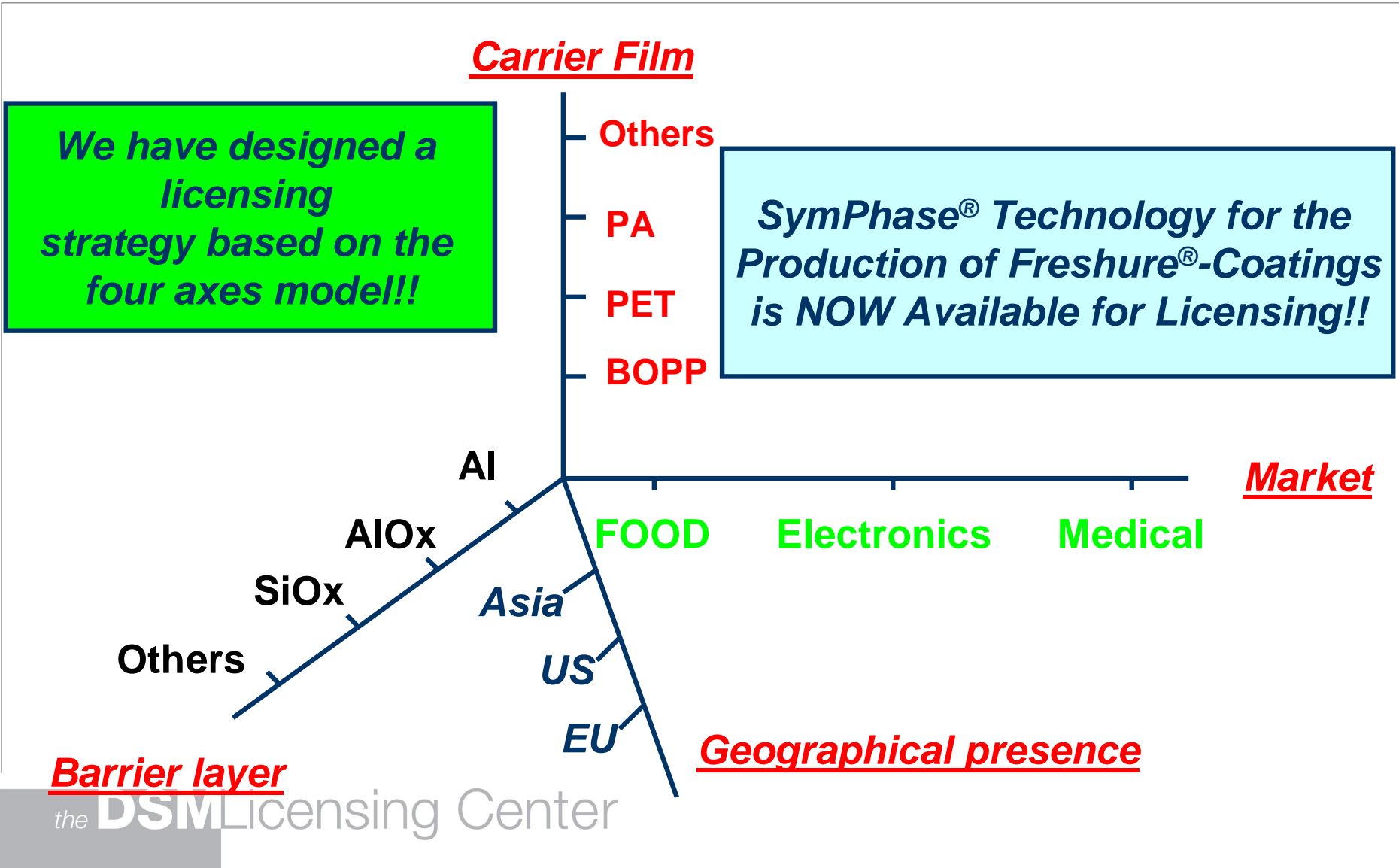
- **PRINTABILITY**

- Freshure<sup>®</sup>-Top Coat on metallized films confers instant printability, in contrast to other metallized films which may require additional off-line primers, with the following disadvantages:
  - Off-line priming damages the oxide/metallized layer
  - Primers may not be “water clear”, reducing metallic gloss
  - Additional production steps and extra cost for the primer

VALUE PROPOSITION

- By introducing the **SymPhase**<sup>®</sup> technology in your metallizers, you will be able to:
  - *Produce cost competitive transparent high gas barrier films (**Freshure**<sup>®</sup>-**Single Coat**)*
  - *Upgrade the performance of your metallized films in terms of barrier and processability (**Freshure**<sup>®</sup>-**Top Coat**)*

BUSINESS MODEL



CONCLUSION

- In cooperation with partners, DSM has developed **SymPhase<sup>®</sup>** Technology; a vacuum coating process for the production of **Freshure<sup>®</sup>-Coatings** for applications in flexible packaging.
- **SymPhase<sup>®</sup>** Technology adds value to coated film business by providing high gas barrier transparent coatings (**Freshure<sup>®</sup>-Single Coat**) and by improving the performance of vacuum coated films (**Freshure<sup>®</sup>-Top Coat**).
- The **SymPhase<sup>®</sup>** Technology is now available for licensing to various members of value chain for flexible packaging.

For more information regarding this patented technology please contact:

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***For more information  
about  
Freshure® Coatings  
please visit our  
website***

***[www.symphase.com](http://www.symphase.com)***