AIMCAL Presentation
Clear barrier films-Process, Performance and Opportunities

This presentation will include information on vacuum deposited clear barrier aluminium oxide or silicone oxide coatings on thin film substrates. The presentation will describe the common production routes, end uses for the structures, growth projections in key market areas and methods to further improve the barrier properties of ALOx and SIOx coated films.

Vacuum deposited clear barrier coatings are dominated by ALOx and SIOx coatings. The relative ease of manufacture and manufacturing cost base are probably the main reasons for the split being 70% ALOx 30% SIOx.

The deposition of ALOx and SIOx is predominantly onto polyester film but there is a significant usage of nylon base films, notably in Japan for retort applications. Whilst the usage of OPP as a substrate film is still small in comparison to PET and OPA it is beginning to make in- roads into certain market areas such as snacks and confectionery.

Manufacturing routes include reactive evaporation of Al and O2 for ALOx and SIO and O2 for SIOx. This process can be carried out in a modified vacuum chamber used for AL metallising. Hence, this tends to be the most cost effective manufacturing route.
Another manufacturing route for both types of oxide is electron beam evaporation whilst PECVD evaporation of Organosilanes is used for the deposition of SIOx coating on thin film substrates.

See slide 1 and 2.

Aluminium and Silicone Oxide coated films have a unique balance of properties which include good oxygen and moisture barrier, excellent clarity-typically 80-90% (visible light), retortability and printability.
The combination of properties and competitive pricing has led to the increased usage of oxide coated films for modified atmosphere packaging (MAP) of meat, cheese and pasta, also for ready meals, retortable pouches, and flow wrapping of confectionery products.
In Europe the market for oxide coated films is supplied by domestic production and by imports from Japan. The main application is MAP. This is now a commodity market, price sensitive and hence ALOx barrier coated films have a majority share. The environmental pressure to replace Saran coated films (PVdC) varies from country to country but is strongest in Northern Europe/Scandinavia countries. The need to find environmentally alternatives to Saran coated films has been a major factor in the growth of oxide coated films for food packaging applications.

Japan has several large producers of oxide coated clear barrier films. Most offer both ALOx and SIOx coated films. Higher barrier grades are used for sensitive food products that are retorted after packing.

The Japanese have led the way in the use of oxide coated films/laminates for retort applications but in the last 5 years there has been significant growth in Europe with major multi-national companies moving food products out of metal cans and glass containers into flexible retortable packaging. It is now common to see products such as pasta, rice and sauces packed in this format.

In the US the usage of Oxide coated clear barrier films is small compared with Europe and Japan. At present there is little environmental pressure to replace Saran as the clear barrier coating of choice. The markets that do exist for oxide coated clear barrier films are supplied by films imported from Europe and Japan.

The growth in the use of oxide coated films for retort applications is predicted to be approx 15-20% per annum. The oxygen and moisture barrier properties of oxide coated films have been, and will continue to be improved, in order to meet the shelf- life demands of food products packed in clear barrier flexible retort pouches.

The typical barrier figures for ‘standard’ grades of ALOx and SIOx coated films are OTR 1-3cc/m2/24hrs (23oC/50%rh) and MVTR values of 1-3g/m2/24hrs(38oc/90%rh)

See slide 3.

To improve the barrier performance, particularly for retort and medical applications, the addition of highly cross linked EVOH or PVOH coatings are applied to the oxide coating. These coatings can be modified to maximise retort stability and/or barrier properties. The addition of these barrier coatings can produce a 10x improvement in both OTR and MVTR barrier.

Multi-national food producers and retailers will continue to push for further improvements in barrier properties to extend the shelf-life of products and assist the move to flexible clear barrier packaging from rigid packaging formats such as metal cans and glass.

The challenge for the producers of oxide coated films is how to meet these increasing demands. Could other clear barrier coatings currently under development be used to further enhance the barrier properties or will they gradually replace oxide coated clear barrier films?

Slide 1.

PRODUCTION ROUTES FOR CLEAR BARRIER VACUUM COATED FILMS

COATING	PROCESS
Al_2O_3	REACTIVE EVAPORATION (ALUMINIUM + OXYGEN)
Al_2O_3	ELECTRON BEAM EVAPORATION
SiO_x	PECVD OF ORGANOSILANES
SiO_x	ELECTRON BEAM EVAPORATION
SiO_x	REACTIVE EVAPORATION (SiO + OXYGEN)
SiO_x/Al_2O_3	ELECTRON BEAM EVAPORATION

Slide 2

Production Routes for Transparent Barrier Films - Costs

COATING	ROUTE	EQUIPMENT COST	MATERIAL COST	PROCESS COST
Al_2O_3	REACTIVE EVAPORATION	LOW	LOW	LOW
Al_2O_3	ELECTRON BEAM EVAPORATION	MODERATE	LOW	LOW
SiO_x	PECVD	HIGH	MODERATE	MODERATE
SiO_x	ELECTRON BEAM EVAPORATION	MODERATE	LOW	LOW
SiO_x	REACTIVE EVAPORATION	LOW	HIGH	MODERATE
SiO_x/Al_2O_3	ELECTRON BEAM EVAPORATION	MODERATE	LOW	LOW
CARBON	PECVD	HIGH	LOW	MODERATE

Slide 3

Properties of Vacuum-Coated Transparent Barrier PET Films

PROPERTY	DEPENDS ON	AlO_x/RE	AlO_x/EB	SiO_x/RE	SiO_x/EB	SiO_x/CVD	C/CVD
OTR *	PROCESS	1 - 3	1 - 3	1 - 3	1 - 3	1 - 3	1 - 3
MVTR **	PROCESS	1 - 3	1 - 3	1 - 3	1 - 3	1 - 10	1 - 3
STRETCH RESISTANCE	PROCESS	3 - 4%	3 - 4%	3 - 4%	3 - 4%	5 - 6%	5 - 6%
RETORTABILITY	SUBSTRATE + PROCESS	GOOD	GOOD	GOOD?	GOOD	POOR?	GOOD?

* cc/m²/24 hours/atmos at 23°C, 50% RH

** gram/m²/24 hours at 38°C, 90% RH

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