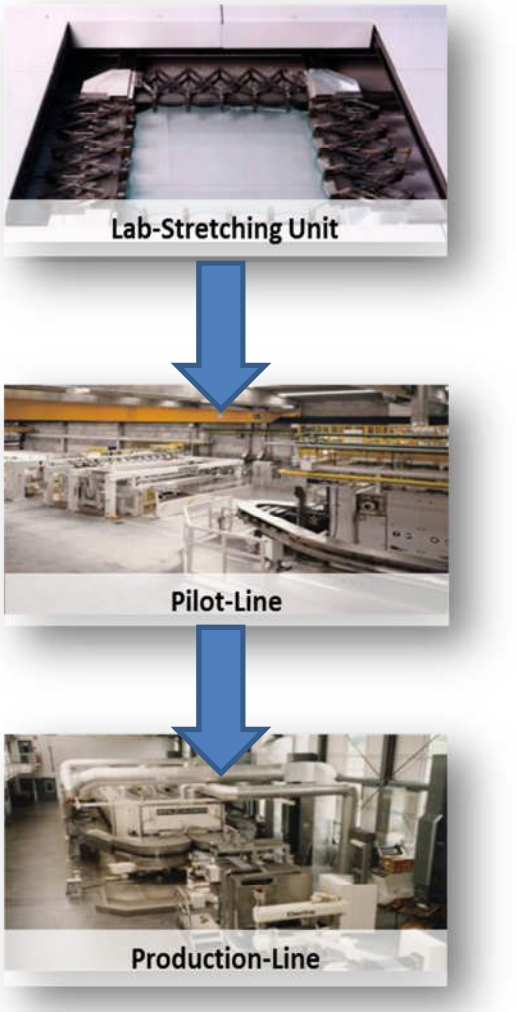
BOPP Capacitor film – simultaneous films with improved properties

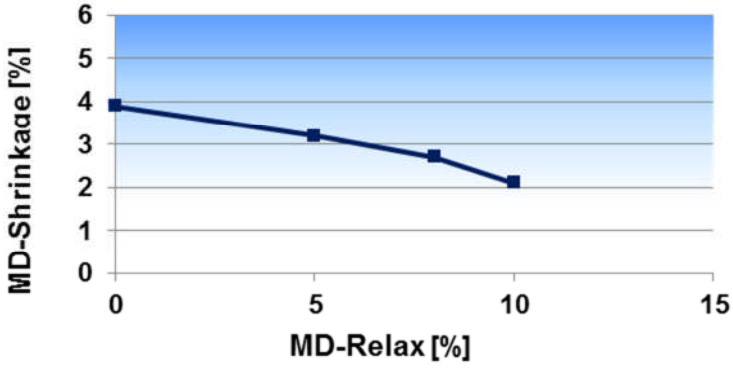
Film capacitors have a dielectric plastic film between the two electrodes. The commonly used plastics are PET, PEN, PP & PPS. Biaxially oriented polypropylene film is the most important film in commercial capacitors. PP is the choice for AC applications caused by low dielectric losses, high rate voltage, low capacity loss with increasing frequency and low isolation current.

Over the next 3 years a solid market growth of 8%/year is expected. In particular motor run capacitors will get an important sector for thin-film applications. Not only battery separator films for electrical vehicles must meet the requirements on a high temperature stability- film, but also capacitor films.

Two main research topics by Brueckner, one goal: To be ready for the new age of electrical vehicles and industrial applications. The first step for Brückner to develop a new thin simultaneous film by LISIM ® technology was to endure the assignability of laboratory stretcher, pilot and production line.



Downgauging to 2.xµm for miniaturization the film capacitors with improved mechanical and electrical properties is the main topic, which is possible with the LISIM® technology. The first advantage of a simultaneous process is to be able to influence the MD (machine direction) shrinkage. With additional relaxation in MD direction which is not possible in the sequential mode, it is feasible to reduce the shrinkage in the common range.



For capacitor manufacturing it is important to have a minimum shrinkage. Depending on the manufacturing process it would be desirable to have zero percent shrinkage in MD and TD direction. Too much shrinkage in MD would provoke a compression of the wound layers, which influences the self-healing conditions and ultimately as a consequence, the self-heating effect causes a breakdown of the capacitor.

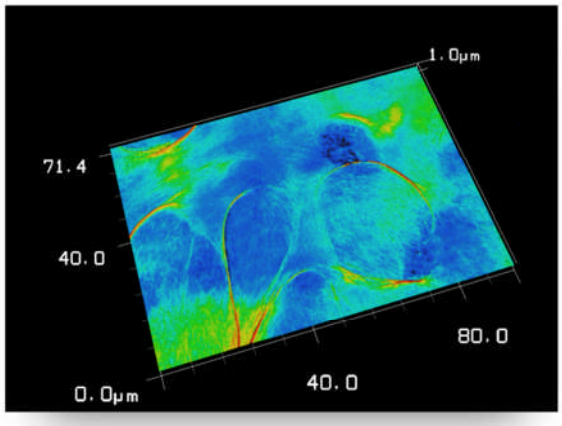
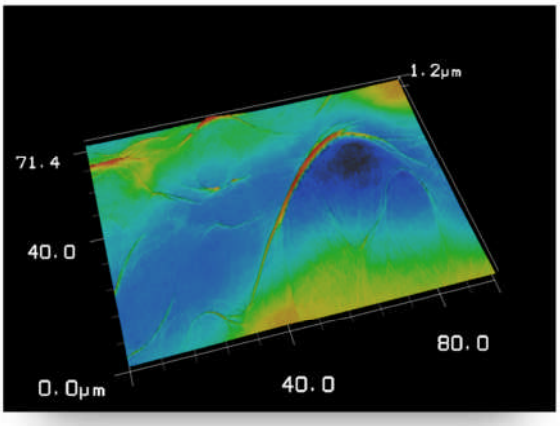
The second advantage of the simultaneous LISIM® technology is the possibility to improve the BDV with boosting the area stretching ratio. The higher the area stretching ratio, the higher the BDV due to a higher cristallinity. Area stretching ratios of ≥60 could be realized. The balanced properties in either direction and the homogeneous thickness tolerances all over the width are also a specific characteristic.

With LISIM® technology a wide range of stretching ratios in MD and TD can be applied, e.g. a typical ratio of 6,5x9,5 leads a good overall properties.
The surface roughness is adjustable. Due to the fact of the flexibility of a LISIM® process by Brueckner, the possible thickness of the BOPP- Capacitor film is not limited by the machine, only the resin borders the range of processing.

Sample			Pilotline sim.	Pilotline sim.	Productionline seq.
Description			2	3	3
Tensile Strength	MD	N/mm²	221	219	177
	TD	N/mm²	283	252	280
Elongation at Break	MD	%	77	87	88
	TD	%	65	65	29
Modulus of Elasticity	MD	N/mm²	3386	3431	2859
	TD	N/mm²	3928	3927	5047
Surface Roughness	Ra	µm	0,07	0,12	0,09
Side A	Rz	µm	0,58	0,74	0,92
	Rmax	µm	1,09	0,89	1,22
	Rt	µm	1,11	0,96	1,26
Surface Roughness	Ra	µm	0,06	0,12	0,06
Side B	Rz	µm	0,38	0,83	0,6
	Rmax	µm	0,45	1,01	0,78
	Rt	µm	0,47	1,08	0,82
Haze		%	1,16	1,83	5,92
Thermal Shrinkage 120/5	MD	%	2,8	2,6	5,1
	TD	%	0,28	0,1	1,3

For higher temperature stability it is important to collaborate with resin producers. The simultaneous process with its flexibility in area ratios is an advantage to processing new resins e.g. high cristallinity PP resins.

The surface structures, which are important for the further processing and also for the self-healing process in the capacitor, could be influenced by the simultaneous process as much as in the sequential process, but the structure are more homogeneous, small and more even distributed

	
Simultaneous 3µm BOPP-C Film, Pilot line	Sequential 3µm BOPP-C Film, Production line

Brückner uses a new laser-scanning-microscope for characterizing the surface structures and determination of roughness profiles. First tests of performance and life time in capacitors with simultaneous oriented BOPP capacitor film showed positive results.

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