

Dielectric and constructive structure - in addition to the electrode used (see the following section: Conductor Materials) - are crucial to the sound characteristics of a capacitor. In order to offer you the optimal capacitor for each application, we use alternative insulation materials in different - some self-developed - patented winding processes.

1.0 Electrolytic Capacitors

Aluminium oxide (Al₂O₃) forms the dielectric in all our electrolytic capacitors. It is also called clay or electrocorundum and is sometimes found as a natural mineral whose crystals are known to us as ruby or sapphire. Al₂O₃ is an extremely hard and resistant insulator with high heat conductivity. In particular, aluminium oxide is characterised by very high dielectric strength and ultra-thin layer thickness and thus allows the manufacture of extremely compact capacitors with an excellent price/performance ratio.

1.1 Polarised Electrolytic Capacitors possess the most compact of structural forms and are therefore used at very high capacities, as required for example, in the voltage supply of amplifiers. However, since they are not AC voltage-proof, polarised electrolytic capacitors cannot transmit audio signals.

1.1.1 MLytic® Power Capacitors have a whole range of special features, all of which serve one purpose: the most authentic music playback possible. A basic requirement for achieving this aim is to minimise the undesired losses (ESR) and inductivities (ESL) occurring in the capacitor that impact negatively on the original signal. The use of high-purity materials for the anode foil and the highest production precision ensure a homogeneous etching structure of the crystalline Al₂O₃ layer, the actual basis for detailed music playback with balanced sound character. The use of a special, titanium-coated cathode foil allows capacitors with unusually low ESR values characterised by 'holographic' spatial music playback with broad and deep on-stage representation and absolutely stable focus.

Between these two foils we combine highly flowable, chloride-free and largely water-free longlife electrolytes with extremely soft special paper (mostly abaca-esparto paper) that is characterized by high mechanical stability, outstanding internal damping and electrolyte absorption capacity. Moreover, we do not use magnetisable, inflexible, poorly conducting steel for the connectors (global snap-in standard); instead we exclusively use highly conductive tin-plated copper wires for the highest currents, alongside the familiar, multiple-contact, solid aluminium screw terminals.

1.1.2 MLytic+® 4-pole Filter Capacitors also combine this outstanding technology. However, contacting takes place at the start and end of the respective foil. Although these low-current types have a comparatively reduced current capacity, they possess outstanding filter characteristics with again reduced ESR and ESL. The engineering office IB Steinbach (ib.steinbach@netcologne.de) is happy to develop corresponding circuits for and with audio manufacturers.

1.2 Bipolar Electrolytic Capacitors (also called non-polarized or NP) possess a second anode foil that makes them AC voltage-proof and thus music signal-suitable. ECap raw possess foils whose surfaces have been roughened and thus enlarged by means of a special etching process. In contrast, ECap plain are made from unetched and thus lower-loss foils.

2.0 Film Capacitors

Polypropylene (PP) is used as the dielectric in all our film capacitors. As a capacitor film PP is globally the No.1. It is a partially crystalline hydrocarbon that reliably fulfils the highest standards of safety in use, pulse handling capability, AC voltage proofness and dielectric strength. The extreme temperature and frequency stability of PP's ultra-low ESR and capacity value is absolutely unique. This is added to by fantastic mechanical features such as the very equal film thickness for the highest precision in production or the high elasticity and thermal plasticity for ultra stable and vibration-cushioned capacitor winding.

Of course, in the past decades we have regularly conducted comparative listening tests with various alternatives (paper, PTFE, polyester, PEN and polycarbonate). Although these materials were – technically and in terms of sound - equal or even superior in some individual aspects, the overall experience was always nicest and the enjoyment of the music the greatest with PP film capacitors*.

2.1 Film/foil capacitors (KP) are wound as conductors from solid metal foils. The enormous conductivity and the high inertia of the metal foil ensures a minimal loss angle and prevents resonances. This leads to very lively playback. The disadvantages of the high use of material are the costs, an increased failure rate due to the physical load of the dielectric and the lack of self-healing properties (i.e. breakdowns in the insulator lead to full signal passage). We therefore advise against use in electronics and in industrial production!

2.2 Metallised capacitors (MKP) are wound using films with a vacuum-metallised metal layer. This modern structure is more compact, more reliable and more value-for-money than film/foil capacitors and also possesses outstanding self-healing properties (i.e. the metal coat evaporates around damaged spots in the dielectric, thus insulating them).

2.2.1 MCap® EVO are metallised PP film capacitors based on the innovative EVOLUTION winding technology, which was launched in the RXF series (Radial eXtra Flat) in 2005. Its main feature is its unusually narrow and high capacitor winding. This geometry produces two acoustically clearly perceptible advantages compared to traditional, easier-to-manufacture MKPs. One advantage is that the shortest, low-loss signal routes as well as particularly large contact surfaces are ensured (and thus extremely low residual resistance ESR); the other advantage is that an extremely large number of windings are parallel-connected, minimising inductivity (ESL). In addition, they are moulded by hand according to the highly precise winding process in specially developed, compact housings. This prevents the winding from vibrating and microphony effects on a sustained basis. In the sound pattern, all these special features are perceived through sound-quality liveliness, nuanced, transparent dynamics as well as outstanding authenticity and stereophony.

2.2.2 MCap® SUPREME are metallised PP film capacitors based on the audiophile SUPREME winding technology. The special layout of the capacitor films makes it possible to interlace two interlying, counterwound capacitor windings in such a way that the inductivities of the individual windings almost cancel each other out. The two windings are connected in series; consequently, two windings, each of 2µF - i.e. in total material for a 4µF conventional structure - are processed to manufacture a 1µF SUPREME capacitor. This process - challenging in production technology terms - which has been offered since 1992 demands the greatest care in production, which is, to a large extent, manual. To rule out colouration of the music signal due to microphony, they are mechanically stabilised by hand in an additional process and moulded in special housings. This high degree of effort is absolutely justified by the fascinatingly realistic music experience, with plasticity of the on-stage representation that is fully released by the loudspeaker and is virtually holographic, with crystal-clear contours and outstanding offset in depth.

2.2.3 MCap® SUPREME EVO are the perfect liaison of the two aforementioned Mundorf MKP special structures and were specially developed for and tailored towards the heightened requirements and increased opportunities of the latest generation of loudspeaker chassis. In addition to increased effectiveness, richness of detail and transmission range, these chassis are characterised above all by a previously unknown synthesis of explosive dynamics and distortion-free silkiness. Our new top class fulfils the high standards by combining the stimulatingly authentic verve with the outstandingly three-dimensional spaciousness of EVO and SUPREME in a virtuoso manner to create brilliant, richly faceted, emotionally captivating musicality and pure listening pleasure.

2.2.4 Oil impregnation of metallised PP film capacitors in vacuo is a particular speciality of our company and was used for the first time with MCap® SUPREME Silver.Oil in 2002. In this process, even the smallest air bubbles are squeezed out of the capacitor winding and even the most subtle of hollow spaces are filled and softened with oil. Both electrical and mechanical losses in the capacitor due to vibration are thus reduced to a minimum. Mundorf oil capacitors are characterised by their extremely sophisticated and highly dynamic detail and are superior to their respective dry counterpart in presence, speed and precision.

The conductor material of the electrode - in addition to the insulator and the structural design (see preceding section: Dielectrics & Structures) - is crucial to the sound characteristics of a capacitor. In order to offer you the optimal audio capacitor for different applications and your individual standards with regard to the range and facet richness of tonality, acoustic colours and overtones, we use five conductor materials of the highest cleanliness.

3.1 Zinc as an electrode material is the specialist for the highest dielectric strength and is therefore used by us in capacitors for the voltage supply of audio electronics. Compared to electrolytic capacitors with a similar purpose and a maximum of 500 to 550VDC, with zinc-damped PP film we can produce AC voltage-proof capacitors in the kV range that have significantly fewer losses, an unlimited lifespan and outstanding self-healing properties. However, due to the acoustic properties we advise against use in audio capacitors!

3.2 Tin is characterised by its particular softness and pliability and is therefore outstandingly suitable for use as a metal foil in KP capacitors. The mechanical load of the dielectric and thus the failure rate are minimised as far as possible through the use of tin foil and internal damping is maximised. The incredible dynamics and the richness of detail that result from this structure compensate for the characteristic acoustic disadvantages of this conductor material.

3.3 Copper* harmonises better with paper than with PP film as a dielectric, in our experience, and thus forms the famous exception to the rule. The outstanding conductivity of copper leads to a dynamic and richly detailed sound pattern with outstanding tonality and naturalness in some frequency ranges; this sound pattern, however, lacks brilliance, balance and precision overall.

3.4 Aluminium is the standard and benchmark in the construction of capacitors, due to its having the highest conductivity of all non-precious metals with respect to weight and its outstanding price/performance ratio. Aluminium MKPs are characterised by richly detailed, lively and harmonious music playback. It is simply indispensable for the manufacture of aluminium electrolytic capacitors on whose anode electrode the dielectric Al_2O_3 is formed (also called anodic oxidation).

3.5 Silver of the highest cleanliness (typically 99.99%) is highly valued and preferred by many audio enthusiasts as a conductor material due to its outstanding ability to reproduce voices and instruments even more dynamically, with greater richness of detail and with more acoustic colours.

3.6 SilverGold 99% silver + 1% gold = 100% music. The use of this conductor material can be condensed into this simple formula. The ultrapure Gold (typically 99.99%) changes the crystalline structure of silver and maximises its very good electrical conductivity. Instruments and voices unfurl their whole range of lively acoustic colours and their character is illuminated and becomes experientable in all nuances. ‚Crystal clear‘ on the one hand, the playback is lively and warm at the same time, embedded into a delicately differentiated picture and steeped in musical beauty. Delicate elegance, tonal purity and its lively dynamics make this exquisite material stand out from all others!