

maxon ceramic: Tough and Precise Microcomponents

Anti-corrosive, temperature resistant, extreme wear and compatible in steel assemblies – is it any wonder that ceramic is a great material to use in DC motors and gearboxes. maxon ceramic is part of maxon motor AG (2500 employees worldwide), a leading company for small drive systems. maxon ceramic offers customised CIM parts all over the world.



Fig. 1
maxon motor GmbH with its ceramics division at Sexau/DE

For over 20 years, maxon ceramic, a specialist maxon motor centre, has been developing and manufacturing components using Ceramic and Metal Injection Moulding, respectively (CIM and MIM) (Fig. 1). These ceramic components are used in aerospace, security technology, industry automation, measurement and testing systems, medical and laboratory technology. The core business of the group are small highly dynamic DC and brushless DC motors, gearboxes, spindle drives, sensors and controls. maxon ceramic is responsible for all the ceramic

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microcomponents, zirconia, CIM, MIM

parts used in these drive systems, to improve the life time and the operational temperature. maxon ceramic also produces customized ceramic parts. Specialised in mechanical loaded parts, the preferred material is ZrO_2 . The activities in dental applications led to the founding of maxon dental in Kenzingen/DE in 2015.

Development and production expertise

The development focus is on the design of new components and uses state-of-the-art CAD technology as well as finite element calculations. The feedstocks for CIM (ZrO_2 , Al_2O_3) and MIM (e.g. 42CrMo4, 316L) are bought in from renowned suppliers. If nec-

essary, the feedstock is individually modified in cooperation with these partners. Using facilities to debind solvent, thermally or chemically, gives maxon ceramic the opportunity to use all standard feedstocks (mix of binder and powder).

In addition to injection moulding, maxon ceramic also extrudes ZrO_2 rods. These rods are used for our standard shafts and spindles. Extruded parts are also the basis of small batches produced by machining the parts before sintering (green parts). The green



Fig. 2
Grinding ZrO_2 ceramic with a diamond wheel

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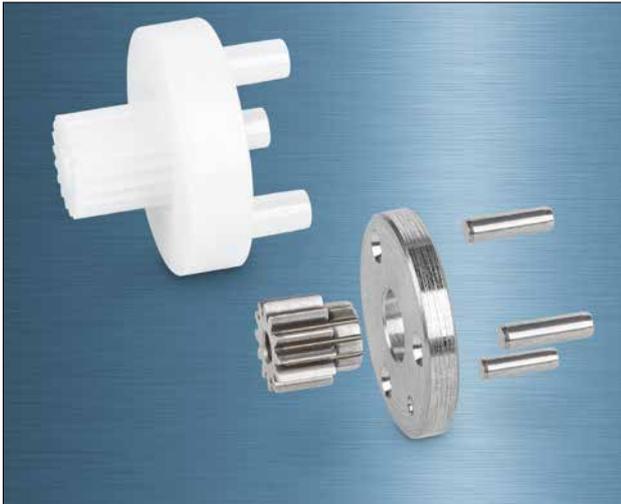


Fig. 3
Planetary carrier made by CIM: simply one part instead of an assembly of five parts



Fig. 4
Size of a carrier of a 8 mm planetary gear in comparison with an USB stick

parts can be machined conventionally by milling and turning. After sintering the part, it can only be machined by grinding (Fig. 2). All these manufacturing methods are used

in-house and give maxon ceramic the opportunity to deliver small and large batches, simple and sophisticated parts of high precision. The typical final process of produc-

ing ceramic parts is polishing. Polishing of the ceramic surface is optimised for technical applications (wear efficiency) as well as optical requirements (brilliant appearance).



Ceramic pawls and gears in automatic watches.

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driven by precision



Fig 5
Ceramic spindle



Fig. 6
Ceramic axis Ø 2 mm and ceramic spindle M2 combined with maxon drive technology to a compact linear unit

To offer a reliable surface quality, different equipment with proprietary – developed abrasives blends – is available. If the application (for technical or aesthetic reasons) needs a dark part, black-stained oxide ceramics are also provided. maxon motor

has a lot of experience in drive systems. Together with the in-house drive specialists, tailored system solutions have been developed and tested. Using planetary carriers made of ceramic by CIM, the user is able to replace an assem-

bly of five parts by one single ceramic part. By avoiding four press fits, the user avoids four latent sources of defects (Fig. 3). Using ceramics, improves the tribology and increases the lifetime of the gear. Manufacturing the planetary carrier by CIM makes the gear more reliable. Handling very small parts, the single part produced by CIM is cheaper than the assembly (Fig. 4). In the future, maxon ceramic will also offer Additive Manufacturing of ceramic components.

Applications

Drive systems

Many of the customers of maxon ask for durable linear drives. Best way to optimise service intervals is to use a ceramic spindle (Fig. 5). The hard material works well even under poor lubrication. Using ceramic spindles is a good alternative for linear drives in adjustable lens systems. maxon manufactures spindles from M2 to M8 (Fig. 6). Two start threads and special threads are also available on demand.

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Using ceramic spindles, the surface pressure in the thread can be significantly higher than by conventional spindles.

The negligible slip-stick effect of ceramic spindles helps to control the position of the nut.

Standard components from the maxon catalogue

In the maxon catalogue and on the website, one will find standardised spindles and axes (www.maxonmotor.ch/maxon/view/content/maxon-ceramic-spindel). maxon also uses these products to design precise and durable devices (Fig. 6).

Customized parts

Watches

The precision of automatic watches is ensured by ceramic pawls made of zirconia, which enable a lifetime so far unmatched by metallic materials (Fig. 7).

Consumer products

Brilliant-polished ceramic surfaces underscore the value of components. Not only in the jewellery industry, but also in high-end products, manufacturers want to match the technical class of their products with their appearance over the long term (Fig. 8).

Fluid technology

Ceramic sensor casings can be used at high temperatures and are resistant to abrasive dust or condensates with corrosive effect (Fig. 9).

Outlook

maxon ceramic continues to invest in modern machine tools to offer small precise parts. Serving the market for increasingly powerful microdrive systems, increasing precision, is the daily adventure.

Using ceramic, an extraordinary wear resistant material, the parts stay very long precise.

maxon offers all kind of small ceramic parts. If the rich experience in driving systems is transferable, maxon will do.

For more information on maxon's ceramic capabilities please contact:

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Fig. 7 Pellaton movement with pawls and cogs made of high-performance ceramics in an automatic watch



Fig. 8 The housing of an in-ear headphone protects the sensitive mechatronics inside over its lifetime; even after years of use, it still looks new



Fig. 9 The casing protects a hot-wire anemometer: the ceramic housing is stable against chemically aggressive environment