Manufacturing Technology / Pressing

EFFICIENT PROCESSES FOR SMALL, MEDIUM-SIZED AND LARGE PRODUCTION RUNS

Piezoceramic disks with center hole

Manufacture of Piezo Components Using Pressing Technology

- Mixing and grinding of the raw materials
- Pre-sintering (calcination)
- Milling
- Granulation, spray drying
- Pressing and shaping
- Thermal processing Sintering at up to 1300 °C
- Lapping, grinding, surface grinding, diamond cutting saws
- Application of electrodes: Screen printing, PVD processes, e.g. sputtering
- Polarization
- Assembling and joining technology for actuators, sound transducers, transducers
- Final inspection

Piezo Components Made by Pressing Technology

Piezoceramic bulk elements are manufactured from spray-dried granular material by mechanical hydraulic presses. The compacts are either manufactured true to size, taking into account the sintering contraction, or with machining excesses which are then reworked to achieve the required precision.

The sintered ceramic material is hard and can be sawn and machined, if required. Screen printing is used to metallize the piezo elements and sputtering processes (PVD) are employed for thin metallizing layers. The sintered elements are then polarized.

Stack Design for Actuators

Piezo actuators are constructed by stacking several piezoceramic bulk elements and intermediate metal foils. Afterwards an outer insulation layer made of polymer material is applied.

Piezo stack actuator

Manufacturing Technology / Tape Casting

PICMA® actuators with patented, meander-shaped external electrodes for up to 20 A charging current

Co-firing Process / Multilayer Technology / Piezo Components in Ceramics Tape Technology

- Fine grinding of the raw materials
- Slurry preparation
- Tape casting
- Application of electrodes by screen printing
- Laminating
- Isostatic pressing
- Thermal processing Binder burn out and sintering at up to 1100 °C
- Grinding
- Application of contact electrodes, termination
- Polarization
- Final inspection

Film Technology for Thin Ceramics

Thin ceramic layers are produced by tape casting. This process can achieve minimal individual film thicknesses of only 50 µm.

The electrodes are then applied with special screen printing or PVD processes.

Multilayer Piezo Actuators: PICMA®

Multilayer co-firing technology is an especially innovative manufacturing process. The first step is to cast tapes of piezoceramic materials which are then provided with electrodes while still in the green state. The component is then laminated from individual layers and electrodes and ceramic are sintered together in a single processing step.

The patented PICMA® design comprises an additional ceramic insulation layer which protects the inner electrodes from environmental effects. Any further coatings made of polymer material, for example, are therefore not required. This means that PICMA® piezo actuators remain stable even when subject to high dynamic load. They achieve a higher reliability and a lifetime which is ten times longer than conventional multilayer piezo actuators with a polymer insulation.

After the mechanical post-processing is complete, the multilayer actuators are provided with contact electrodes and are polarized.

All Possible Shapes Even with Full-Ceramic Encapsulation

PI Ceramic can manufacture almost any shape of PICMA® multilayer piezo actuator using the latest production technology. Hereby, all surfaces are encapsulated with ceramic insulation.

We can manufacture not only various basic shapes, e.g. round or triangular cross-sections, but also insulated center holes on benders, chips or stack actuators, making it easier to integrate them.

Special milling machines work the sensitive ceramic films in the green state, i.e. before sintering. The individual layers are then equipped with electrodes and laminated. The co-firing process is used to sinter the ceramic and the internal electrodes together, the same process as with PICMA® standard actuators.

PICMA® Longlife Multilayer Piezo Actuators

Automatic soldering machine with PICMA® actuators

The internal electrodes and the ceramic of PICMA® multilayer actuators are sintered together (co-firing technology) to create a monolithic piezoceramic block. This process creates an encapsulating ceramic layer which provides protection from humidity and from failure caused by increased leakage current. PICMA® actuators are therefore far superior to conventional, polymer-insulated multilayer piezo actuators in terms of reliability and lifetime. The construction with ceramic encapsulation also gives rise to a high resonance frequency, making the actuators ideal for high-dynamic operation.

Large Temperature Range – Optimum UHV Compatibility – Minimal Outgassing – Neutral in Magnetic Fields

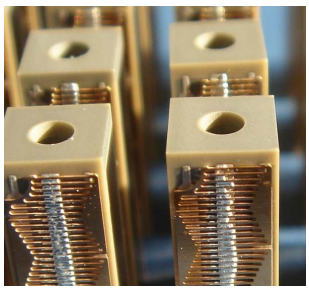
The particularly high Curie temperature of 320 °C gives PICMA® actuators a usable temperature range of up to 150 °C, far beyond the 80 °C limit of conventional multilayer actuators. This and the exclusive use of inorganic materials provide the optimum conditions for use in ultra-high vacuums: No outgassing and high bake-out temperatures. PICMA® piezo actuators even operate in the cryogenic temperature range, albeit at reduced travel. Every actuator is constructed exclusively of non-ferromagnetic materials, giving them extremely low residual magnetism of the order of a few nanotesla.

Low Operating Voltage

In contrast to most commercially available multilayer piezo actuators, PICMA® actuators achieve their nominal displacement at operating voltages far below 150 V. This characteristic is achieved by using a particularly fine-grained ceramic material which means the internal layers can be thin.

The PICMA® actuators are at least partially protected by the following patents:

German Patent No. 10021919
German Patent No. 10234787
German Patent No. 10348836
German Patent No. 102005015405
German Patent No. 102007011652
US Patent No. 7,449,077



PICMA® actuators with hole

For more information visit http://www.piceramic.com