

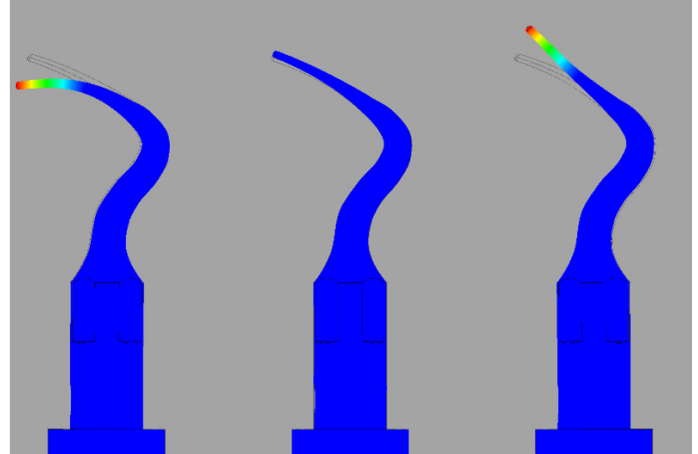
Ultrasonic Dental Scalers

Piezoelectric transducers for use in ultrasonic scalers

Piezoelectric transducers are used by dental surgeons in ultrasonic dental scalers for scaling and root planning, which involves the removal of plaque, stains, tartar or calculus on the surface of teeth and roots. This technology presents significant advantages in cleaning efficiency compared to manual instruments and can broaden the range of applications by its non-magnetic character compared to magnetostrictive technology.

HOW IT WORKS

The piezoelectric element in ultrasonic dental scalers operates as a transducer by rapidly changing size when excited by an electrical signal at high frequency. The scaler tip insert vibrates against the tooth, creating ultrasound waves that break apart the hard calculus on the tooth structure. Water also flows out of the scaler, and combined with the vibration, produces a cavitation effect where millions of tiny bubbles collapse with enormous energy, causing the cell walls of bacteria in the plaque to break up.



Finite element analysis showing the vibration mode of a dental scaler tip

Piezoelectric scalers usually operate in the low ultrasonic range, typically 25-50 kHz, with peak powers reaching up to 25 W. The handpiece can be adapted to several tasks from gentle cleaning to extraction, simply by changing the tip and power level.

WHICH PIEZO ELEMENTS CAN BE USED FOR ULTRASONIC DENTAL SCALERS?

Ultrasonic transducers for dental scalers are usually constructed with a stack of piezoelectric monolayer ceramic with a ring shape, allowing the stacking and cooling system to pass through the handpiece. The stack of ceramic elements is bolted to a coupling horn that amplifies the tip movement. Hard-doped materials such as NCE81/K1000 to NCE40/K1300 are preferred in order to deliver high power without excessive heat generation, thanks to their optimized formula and very low dielectric loss factor.



MAIN MATERIAL PROPERTIES FOR DENTAL SCALER APPLICATIONS

Property	Recommended Materials for Ultrasonic Dental Scalers	
	High Power NCE81	General Purpose NCE40
Dielectric constant K^T_3	1030	1250
Dielectric loss factor at 0.4kV/mm	0.006	0.011
Mechanical quality factor Q_m	1300	700
Coupling coefficient k_t	0.47	0.48

CUSTOMIZATION AND VALUE-ADD

Each company that CTS partners with has unique needs that require custom solutions. Our internal team of engineers and subject matter experts work directly with customers, designing solutions that meet demanding specifications.

Typical customization and value-add opportunities for bulk rings in dental scaler applications are:

- **Electrode shape.** In place of standard plain electrodes, CTS can print a pattern, such as margins on the outer and inner diameter. This allows a better control of the capacitance as well as electrical isolation when assembled into a stack.
- **Surface finish.** Smoother surfaces are sometimes preferred for high power transducers. A smooth surface can improve coupling and sound transmission in the transducer.
- **Tighter thickness tolerance.** Thickness can be adjusted to match either tight frequency or mechanical tolerances. A frequency tolerance down to 2% and dimensional thickness tolerance down to $\pm 0.05\text{mm}$ allow a low batch-to-batch dispersion for consistent operation of the scaler.
- **Transducer design, stacking, assembly and wiring.** CTS can support with the design of the transducer as well as assemble and wire transducers in order to facilitate integration.
- **Specific measurement.** In addition to the usual frequency and coupling measurements, CTS has the capability to perform additional measurements. For instance, dissipation measurement to ensure the transducer meets required power levels.



PIEZOELECTRIC EXPERTISE

A leading developer and manufacturer of high-performance piezoelectric materials and components, CTS' piezo products come in a variety of compositions, geometries, and dimensions with high quality standards to meet demanding requirements. Our portfolio encompasses bulk and multilayer ceramics, single crystal, as well as sub-assemblies, composites, and transducers based on these products.

ABOUT CTS

CTS is a leading designer and manufacturer of products that Sense, Connect, and Move. We manufacture sensors, actuators, and electronic components in North America, Europe, and Asia, and provide solutions to OEMs in the in the aerospace & defense, medical, industrial, communications, information technology, and transportation industries.

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