# Hand-generated Piezoelectric Mechanical-to-electrical Energy Conversion Plasma*

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This work examines electrical characteristics of the transient spark generated by a manually-powered piezoelectric mechanical-to-electrical energy conversion device. The transient spark is a streamer-to-spark transition discharge at atmospheric pressure that has potentials in pollutant removal, medicine, water treatment, nanomaterial synthesis, combustion, and flow control. Conventional methods to generate transient sparks usually require a high-voltage input at nanosecond pulses. Piezoelectric crystals offer a path to create plasma devices that do not require a high-voltage power supply and can be powered with mechanical work. Here, a piezoelectric igniter was utilized as the plasma source, and a snail cam-and-follower actuator was designed to provide repeatable mechanical actuation. Electrical analysis of the generated discharge shows that it behaves as a transient spark, discharging 0.96 mJ over approximately 30 ns, with consistent behavior over multiple consecutive actuations. While this specific device has a low mechanical-to-plasma energy conversion efficiency of 1.54%, its relatively short resetting time of ~8 μs suggests that it could be operated with mechanical input up to nearly 125 kHz. This work with a manually-powered piezoelectric plasma device shows the potential that *in situ* pollution mitigation or plasma-enhanced combustion can be applied to off-the-grid situations by recovering waste energy of other mechanical systems. Greater promise can be achieved with mechanical systems that naturally operate at frequencies similar to the maximum achievable by this piezoelectric system, such as the high-frequency oscillating or rotating components of internal combustion engines and turbomachinery.

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