



## Radioisotope-Powered Piezoelectric Generators: Methodology and Possibilities in Energy Harvesting

Elisabeth J. Schricker,  
Jackson M. Thompson, and Corey D. Phillips

Doctor Kasra Daneshvar  
Summer Ventures in Science and Mathematics  
The University of North Carolina at Charlotte

## Abstract

This paper covers a variety of aspects concerning radioisotope-powered piezoelectric generators (RPG) by discussing topics such as the scientific knowledge of such devices, its mechanical designs, its uses and importance in energy harvesting, and its efficiency, popularity, and economical feasibility. RPGs use a cantilever beam and a thin film of radioactive material to provide mechanical stress for a thin-film piezoelectric generator. A collector, hung from the radioactive film, receives Beta electrons emitted from the radioactive film, which is placed parallel to the collector across a small gap. As the collector accumulates a negative charge and the film gains a positive charge as a result of Beta electron transfer, the collector (and the cantilever beam) is drawn closer to the stationary radioactive thin film, makes contact, and the charges are neutralized. Through this reciprocation cycle, a piezoelectric unimorph thin-film gathers energy from the cantilever's oscillation upon release. Piezoelectricity is the charge that select crystals, ceramics, and biological materials produce as a result of mechanical stress or strain. Stress or deformation of such materials leads to a charge separation across the apparatus. This charge separation, which is essentially a displacement of charges that shifts positive and negative dipoles in the material, creates an electric field and subsequently produces electrical energy as the atoms revert back to their former shape. RPGs are becoming increasingly important as the demand for alternative energy grows, and is practical for sub-millimeter, long term, low power applications or charging a trickle battery. Despite its microscopic size, RPGs have proved up to 3.97% overall energy conversion efficiency, providing more power per cm<sup>3</sup> than commercial chemical batteries.