**A Method to Enhance Transducer Coupling Coefficients**



Fig. 1: Dependence of Device Coupling Coefficient on Axial Load

**Disclosure Number**

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**Patents Issued**

* [6236143](http://www.google.com/patents/US6236143)

**For Licensing Information**

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This invention provides a method which allows actuator and sensor designers to achieve device coupling coefficients and energy conversion effectiveness higher than currently believed possible. This will improve device sensitivity and performance while reducing weight and power requirements.

**Background**

A coupling coefficient is a measure of the effectiveness with which a shape-changing material converts the energy in an imposed signal to useful mechanical energy (or the converse). Devices made using such materials are also said to have coupling coefficients. There are different kinds of material and device coupling coefficients, corresponding to different modes of excitation and response. Device coupling coefficients are properties of the device and, although related to the material coupling coefficients, are generally different from them. It has been commonly held that a device coupling coefficient cannot be greater than some corresponding coupling coefficient of the material used in the device.

**Invention Description**

This invention provides a method which allows actuator and sensor designers to achieve device coupling coefficients and energy conversion effectiveness higher than currently believed possible. This will improve device sensitivity and performance while reducing weight and power requirements. Using this invention it is possible, in principle, to achieve device coupling coefficients higher than material coupling coefficients, and to more than double energy conversion effectiveness relative to state-of-the-art transducers. Penn State researchers have validated the physical principles underlying the invention in experiments with a piezoelectric bimorph device.

**Advantages**

* Increasing device sensitivity with decreased device size and power requirements
* Useful for hydrophones, medical transducers, ultrasonic NDE transducers, structural positioning and control actuators, and piezoelectric bender-type devices
* Important for Micro-Electro-Mechanical Systems (MEMS) devices, where efficiency is critical