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# Non-Confidential Description - PSU No. 2324
# "A Process for Fabricating Spherical Electroactive Devices"

**Keywords:**

electroactive devices, fabrication, hollow spheres

**Links:**

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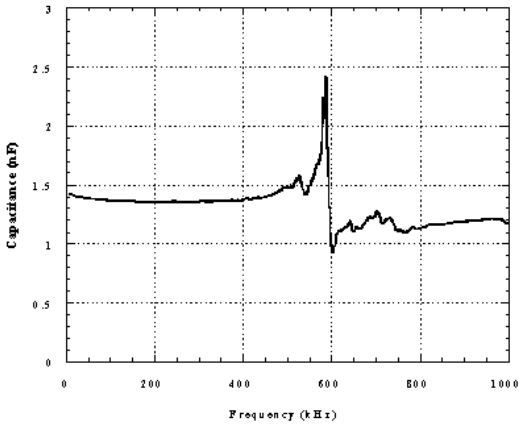


**Fig 1:** the capacitance of a hollow sphere transducer fabricated using this process.

## Background

Currently, catheters of a few millimeters in diameters are inserted into blood vessels for medical procedures or drug delivery. Such catheters are guided with real-time X-ray imaging (fluoroscopy). Ultrasound imaging offers advantages over X-ray imaging in terms of cost, safety and availability. However, because the catheter itself may reflect the ultrasonic beam, ultrasonic imaging is limited by being highly directional dependent. Spherical transducers mounted onto the catheter can serve as an omnidirectional receiver, which generates a signal marking its position in the ultrasound image. Although polymer-based piezoelectric materials can be easily fabricated into different shapes, including spheres, such materials have high losses and low electromechanical coupling coefficients. These polymers also have low dielectric constants, making impedance matching difficult. Solid core ceramic spherical transducers can be fabricated, but their sensitivities are much lower than hollow spherical transducers. Ceramic hollow sphere transducers have the required omnidirectionality and high sensitivity and can be easily matched to the electronic systems. Unfortunately, hollow sphere transducers have been previously extremely difficult to fabricate in large quantities at low costs, thereby inhibitiing their commercial utility.

## Invention Description

The subject invention represents a novel, economical process to produce hollow sphere transducers. The process allows for uniform wall thickness and a fully densified ceramic body. The inventors have represented that this process shall allow for highly reproducible and low cost hollow spheres to be manufactured. Individually tailored spheres can be produced consistently to conform with a product application's unique physical and performance specifications. The Penn State researchers have reported that they have been produced hollow spheres as small as several tenths of millimeters and above. The resonance frequency of the breathing mode of these transducers can be pushed up to several MHz or higher. Given the size of these spheres and their reproducibility, arrays of spheres may be strung together on a metal wire.

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