SOL-GEL DEPOSITED TRANSDUCERS CHARACTERISTICS:A WEIGHT PERCENT STUDY

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Introduction

Monitoring functional machinery components that operate at elevated temperatures is costly and time consuming. This work explores leave in place composite transducers for high temperature monitoring of machinery components. A theoretical model was developed utilizing software provided by NASA. This model was then compared to the experimental results.

Objectives

The objective is to determine the characteristics of a set of spray-on composite transducers to identify the ideal transducer for any situation where a certain specification is made:

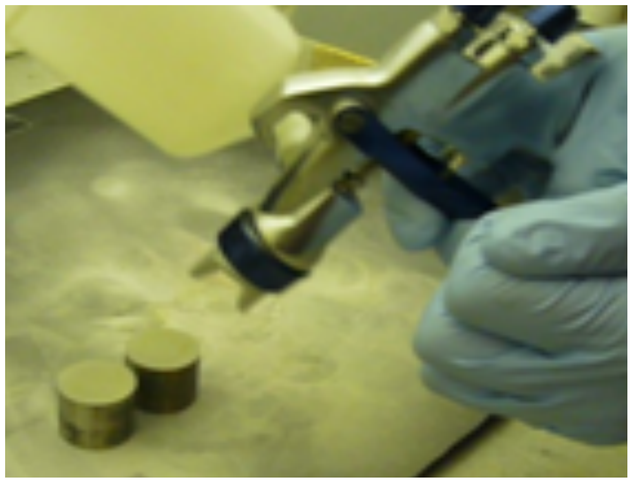
- Operating temperature
- Signal amplitude/Signal to noise ratio
- Specific material property

Methods

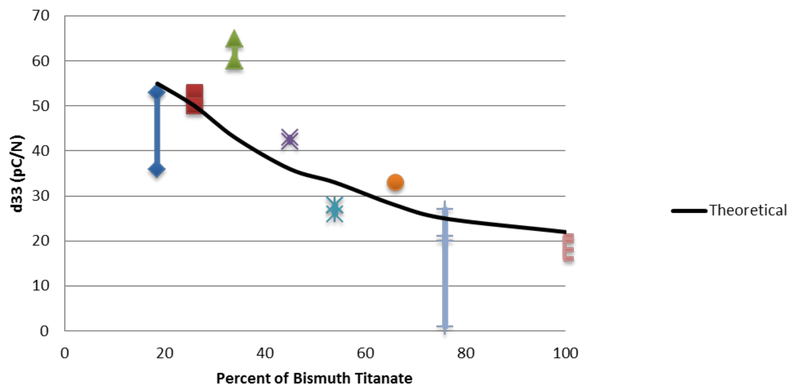
The transducer is fabricated through a sol-gel deposition process that utilizes spraying the transducer onto the substrate.

A sol-gel solution containing bismuth titanate is mixed with a combination of bismuth titanate and lead zirconate titanate(PZT) powders to create a composite transducer.

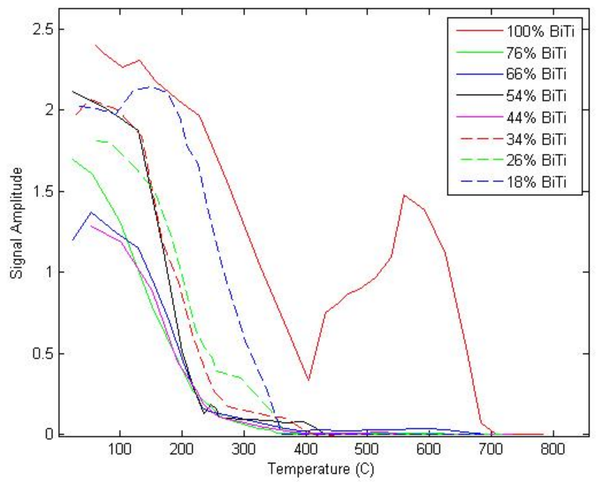
Typical sintering methods have proved to be destructive and difficult to handle for the sol-gel deposition method; however, induction sintering has proved effective.



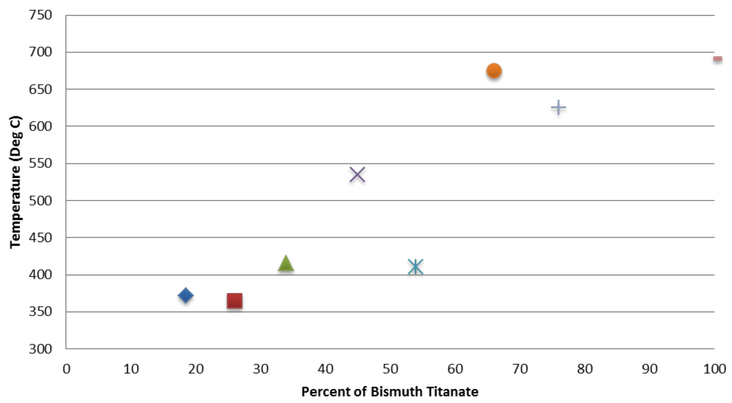
Results



Theoretical modeling and experimental results of the d_{33} of the composite transducer as a function of composition at room temperature.



Experimental signal amplitude as a function of temperature.



Maximum usable temperature as a function of the composition of the transducer.

Conclusion

-d_{33} decreases with increasing weight percent of bismuth titanate
-the maximum useable temperature increases with increasing weight percent bismuth titanate
-signal amplitude is also higher with increasing weight percent of bismuth titanate

The ideal composition for the best signal amplitude and the highest operating temperature has been shown to be pure bismuth titanate; however, if the properties of the transducer are of utmost importance including conductivity and density then PZT should be added to increase these properties.

The theoretical NASA Micromechanical Analysis Code by Generalized Method of Cell model has been validated through the experimental results of these experiments.

Future Work

Now that the composition of the transducer has been optimized to a specific application the future work is comprised of:

- Utilizing the information to evaluate wall thickness
- Integrating the optimized transducer with a wireless system for remote monitoring of mechanical component
- Establishing a field deposition method for the spray-on transducer

References

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