Layered Ceramic Composite System for Application as Temperature Sensor

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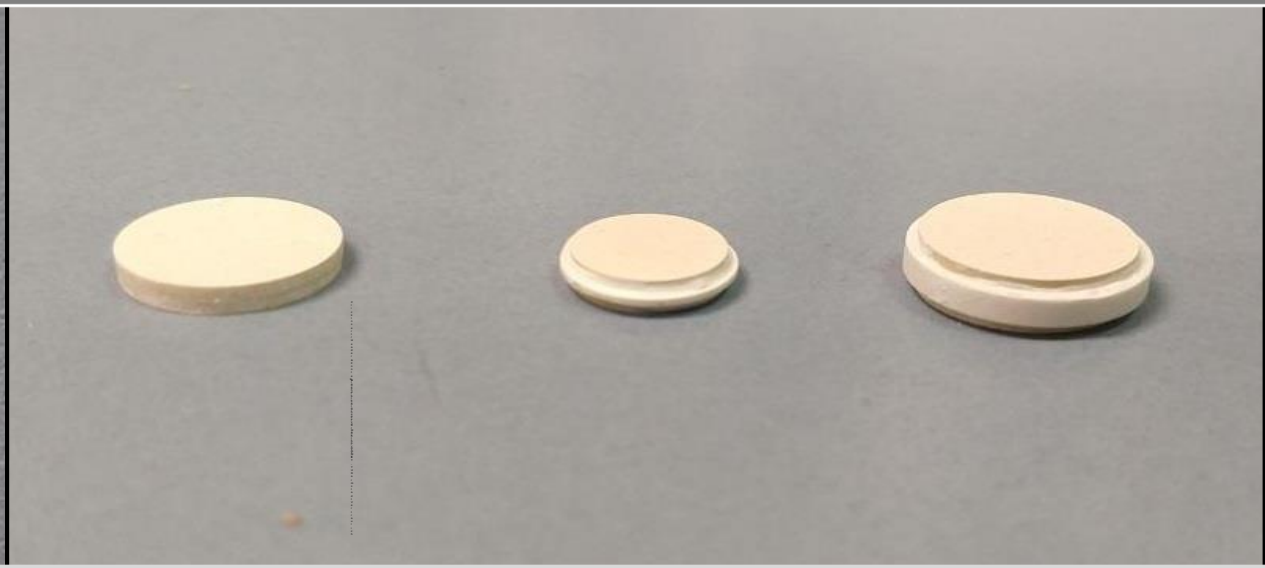
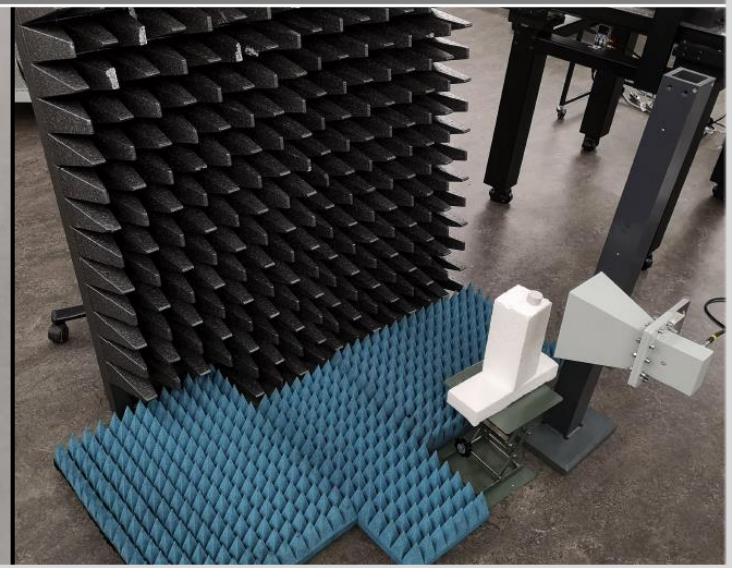
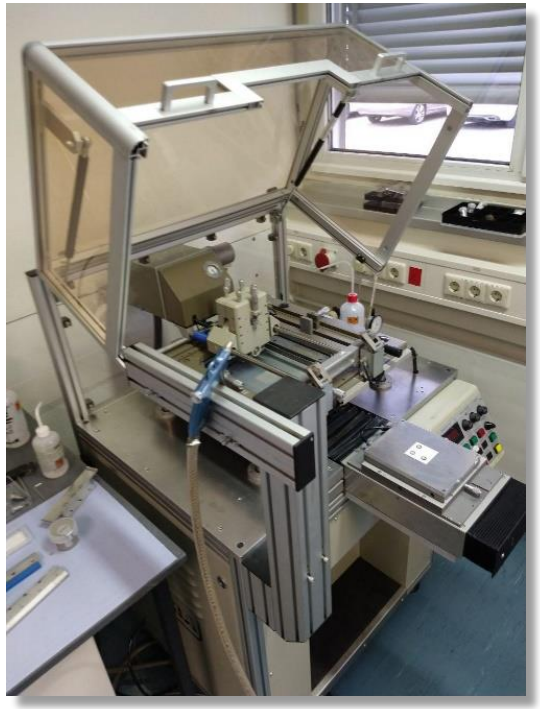
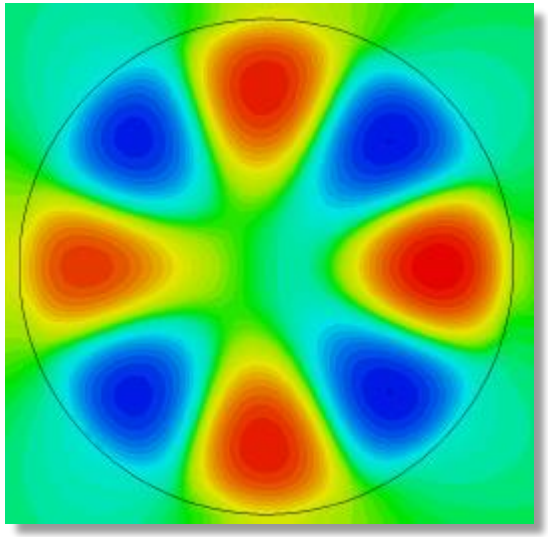




Topics

- Basic concept
- Previous work
- Experimental procedure
- Material results
- Dielectric results





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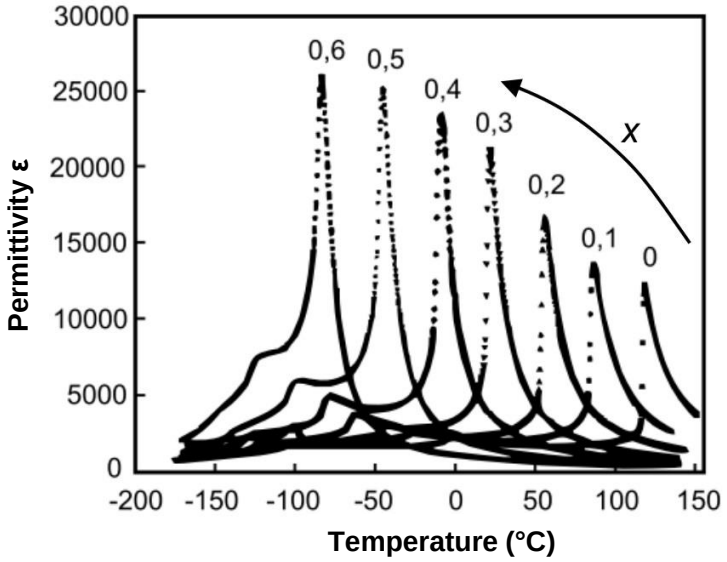
Basic Concept

- Temperature sensor via temperature dependant permittivity of ferroelectrica

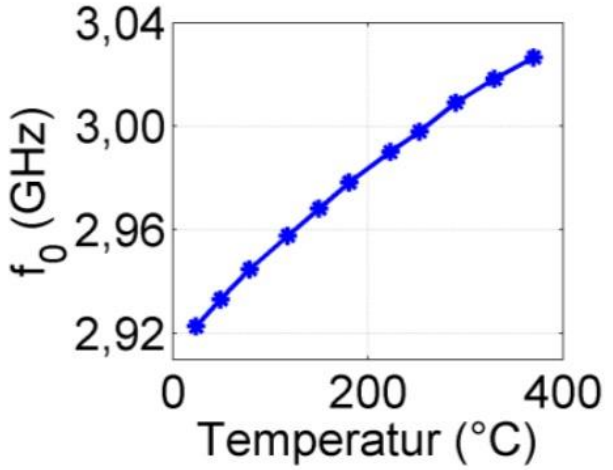
$$\varepsilon_r \approx \frac{C}{T - T_c}$$

$$\omega_0 = \frac{c_0}{\sqrt{\varepsilon_r \mu_r}} \sqrt{\sum_i \left(\frac{n_i \pi}{l_i}\right)^2}$$



Permittivity of $Ba_{1-x}Sr_xTiO_3$

Jeon, J., *J. Eur. Ceram. Soc., 2004, 24, 1045 – 1048*



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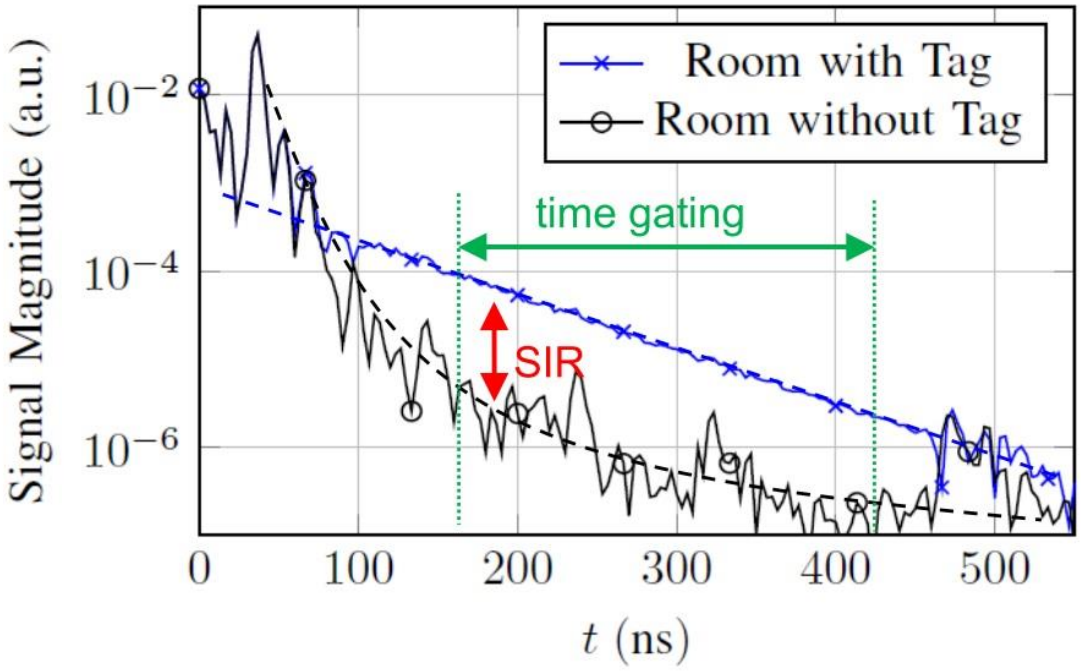
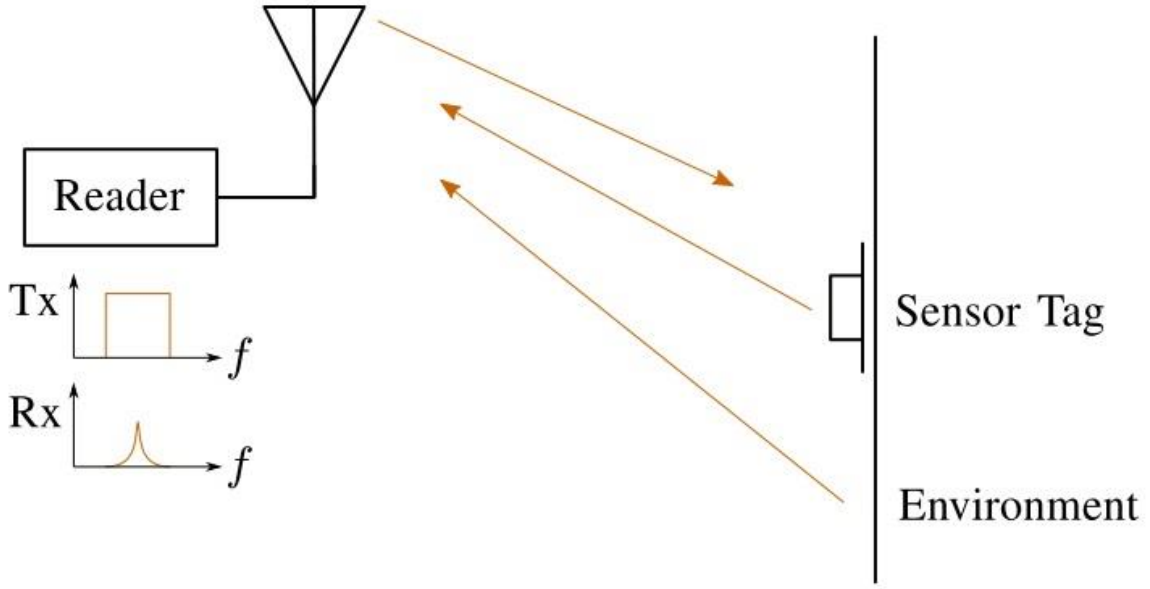
Basic concept

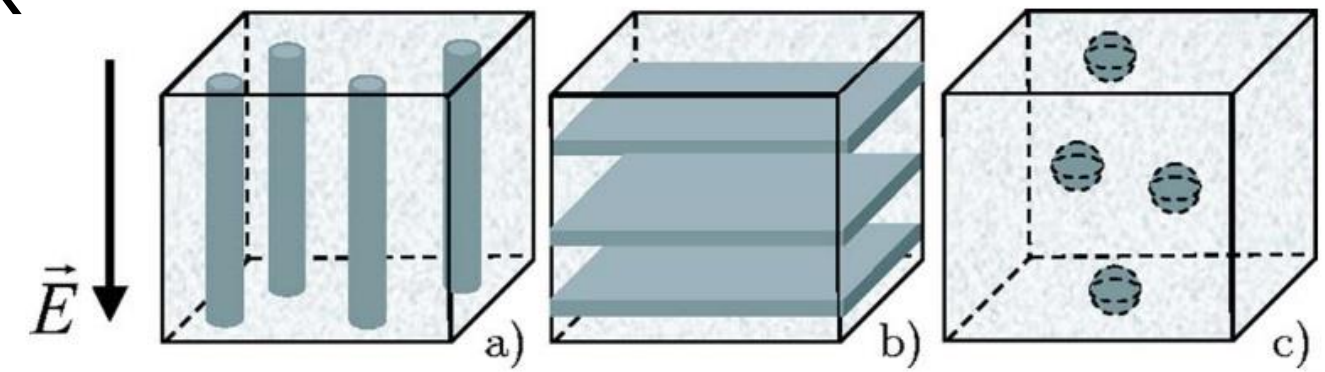
- Detection of the backscattered signal

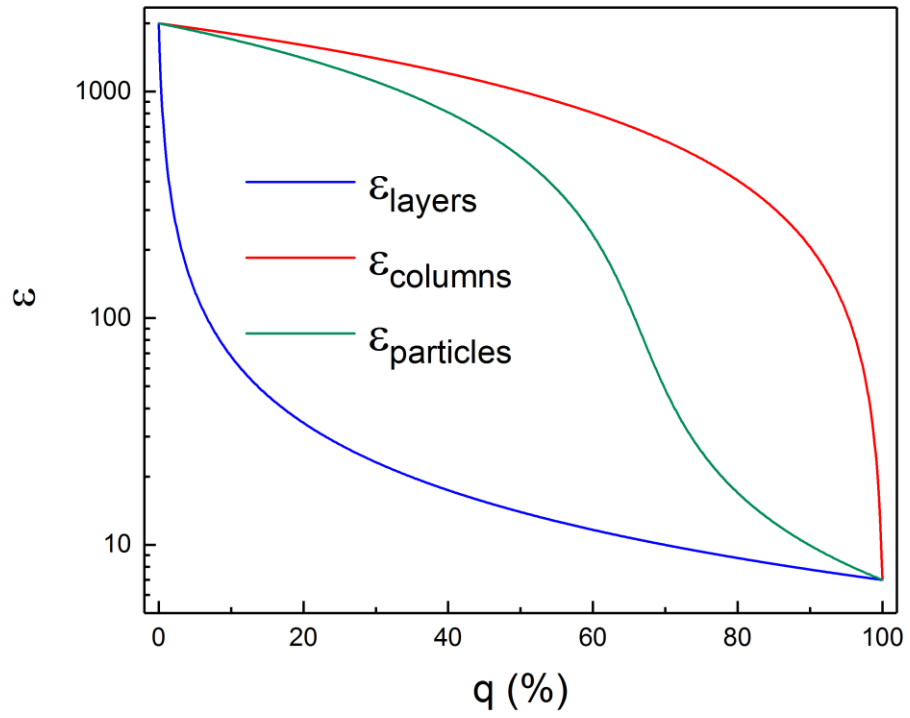


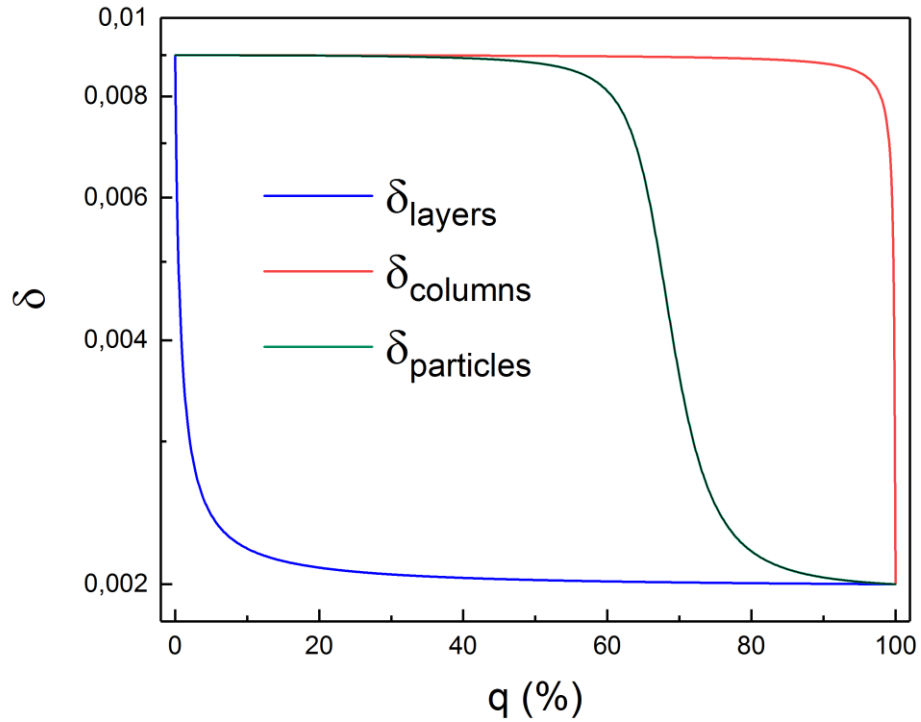


Kubina, Bernd et al. 2013, *Proceedings of IEEE Sensors*: 0–3.

Previous work







Sherman, Vladimir O. et al. 2006, *Journal of Applied Physics* 99(7).

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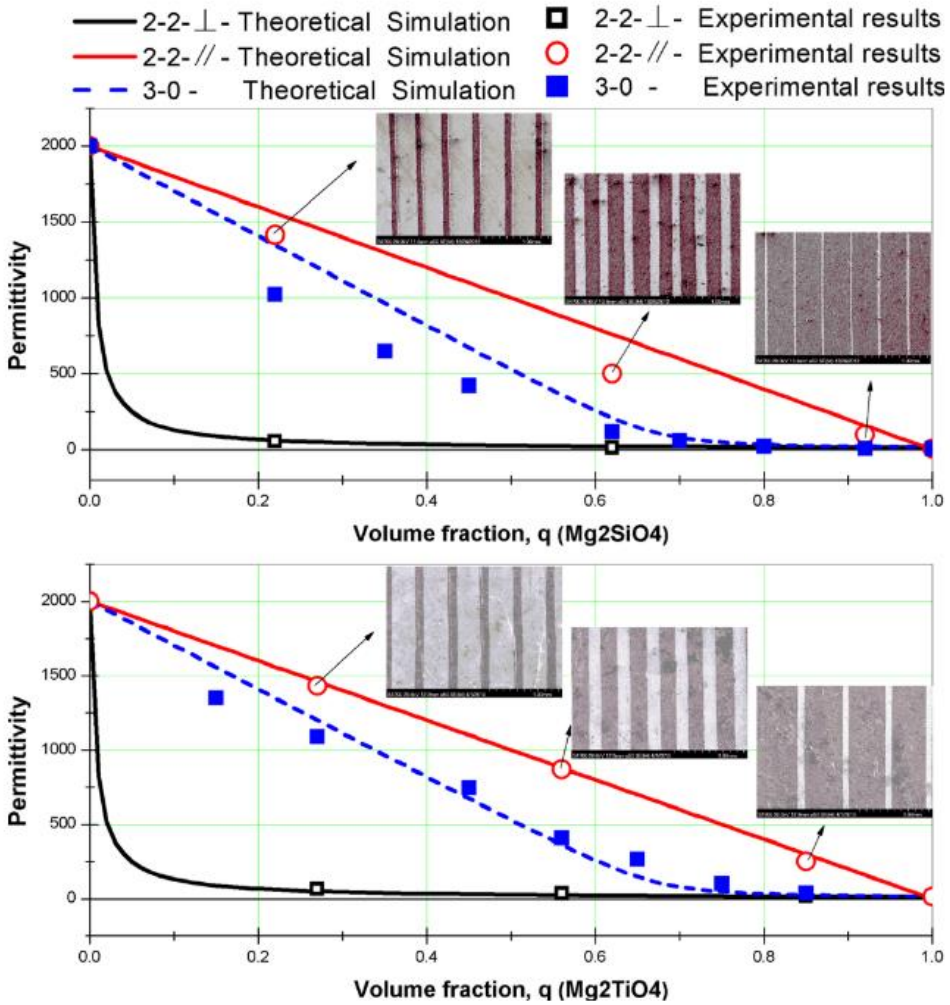
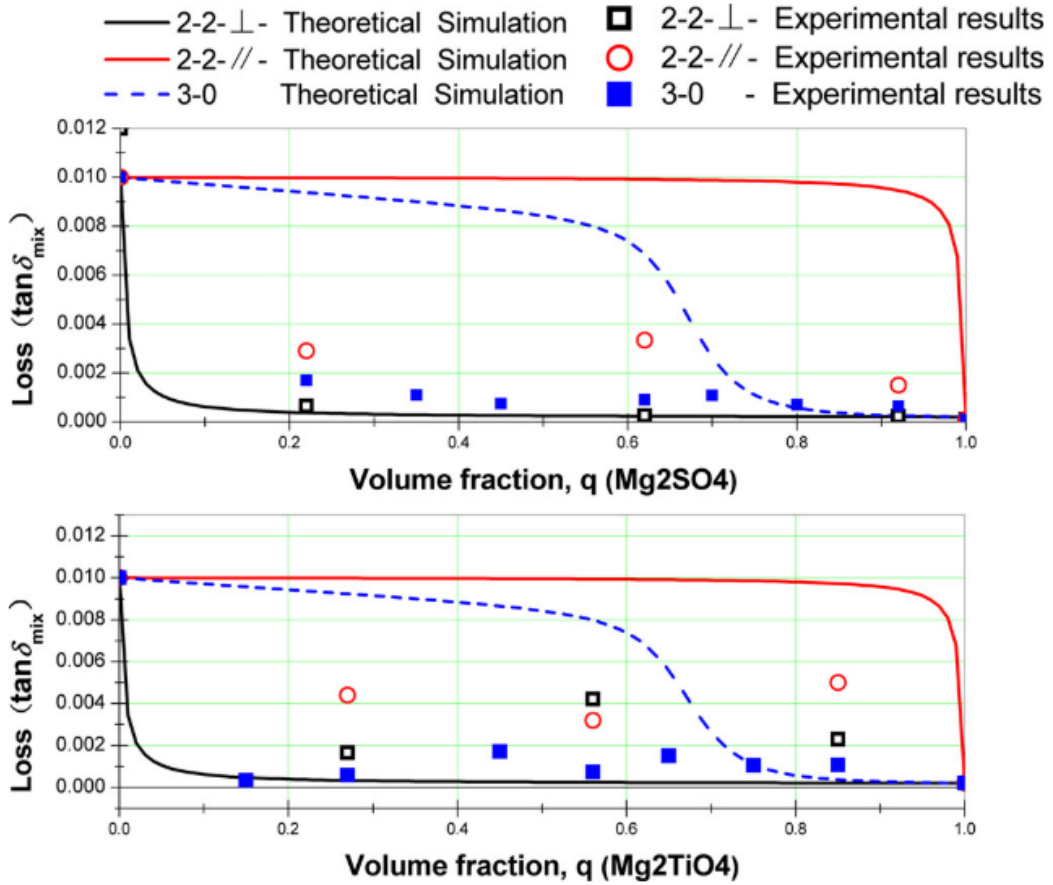
Previous work





Tang, L. et al., *J. Am. Cer. Soc.* 97(3): 862–67

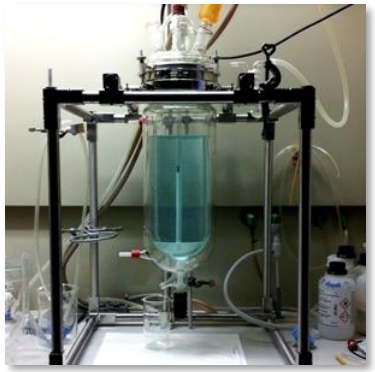
Experimental procedure

HDK: $Ba_{1-x}Sr_xTiO_3$

<u>High temperature coefficient of permittivity</u>

Synthesis via Sol-gel or mixing oxide process,

optional doping and particulate mixing with NDK



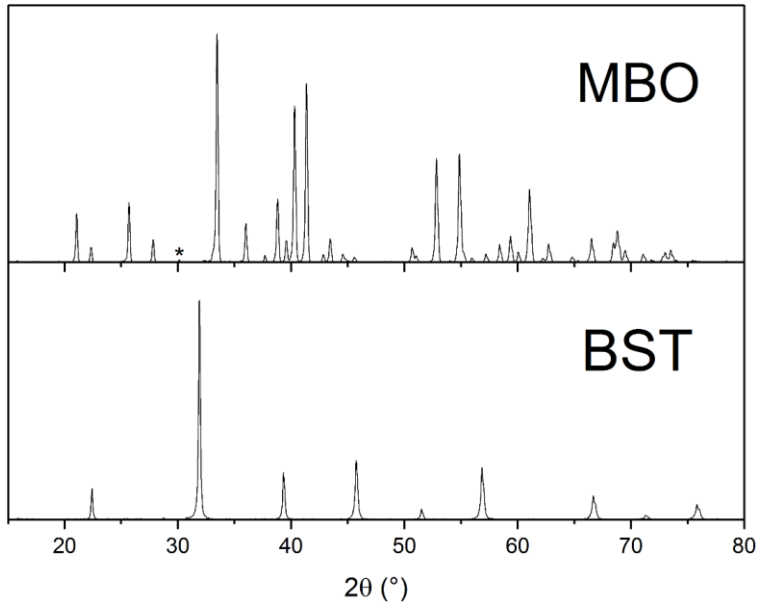
	Qf_0	$\max \frac{\delta \varepsilon_r}{\delta T}$
$Ba_{0,6}Sr_{0,4}TiO_3$	132 GHz	~ 0,2 K^{-1}
$Mg_3B_2O_6$	$>3 \cdot 10^5$ GHz	~ 10^{-3} K^{-1}

Kohler, C., *Anorganische Barium-Strontium-Titanat-Komposite für die Hochfrequenztechnik, 2016*

NDK: $Mg_3B_2O_6$

<u>High Q-factor</u>

Synthesis via mixing oxide process



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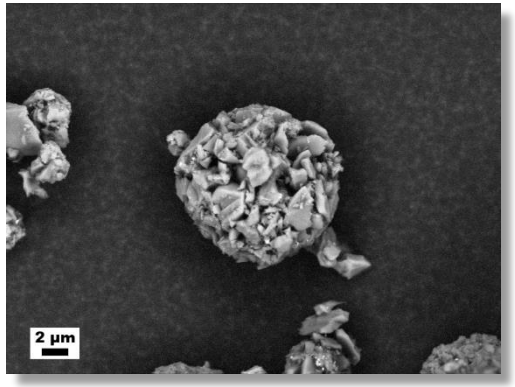
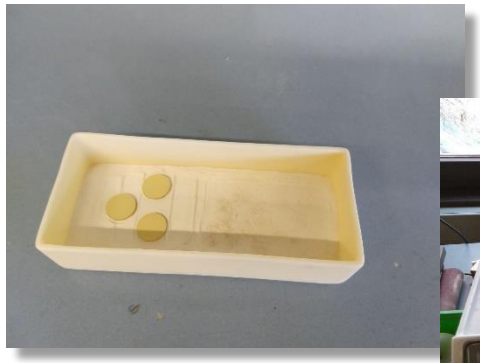
Experimental procedure



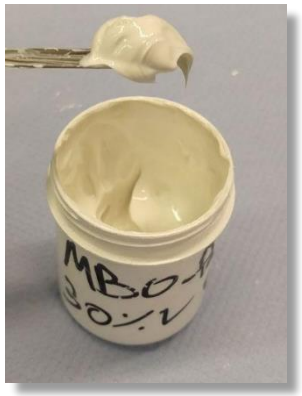
Addition of binder and granulation of BST for better pressing behavior

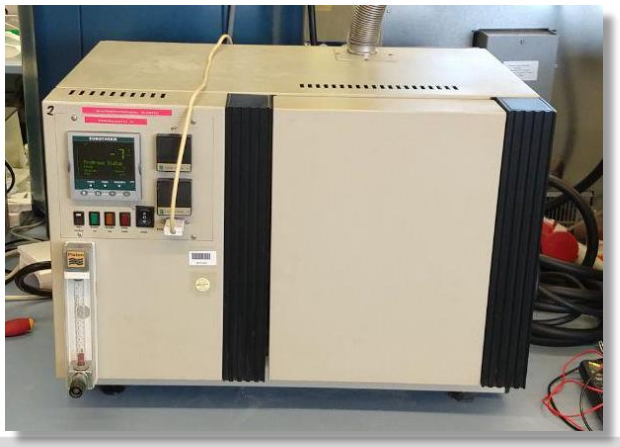


Pressing, sintering and lapping of BST pellets

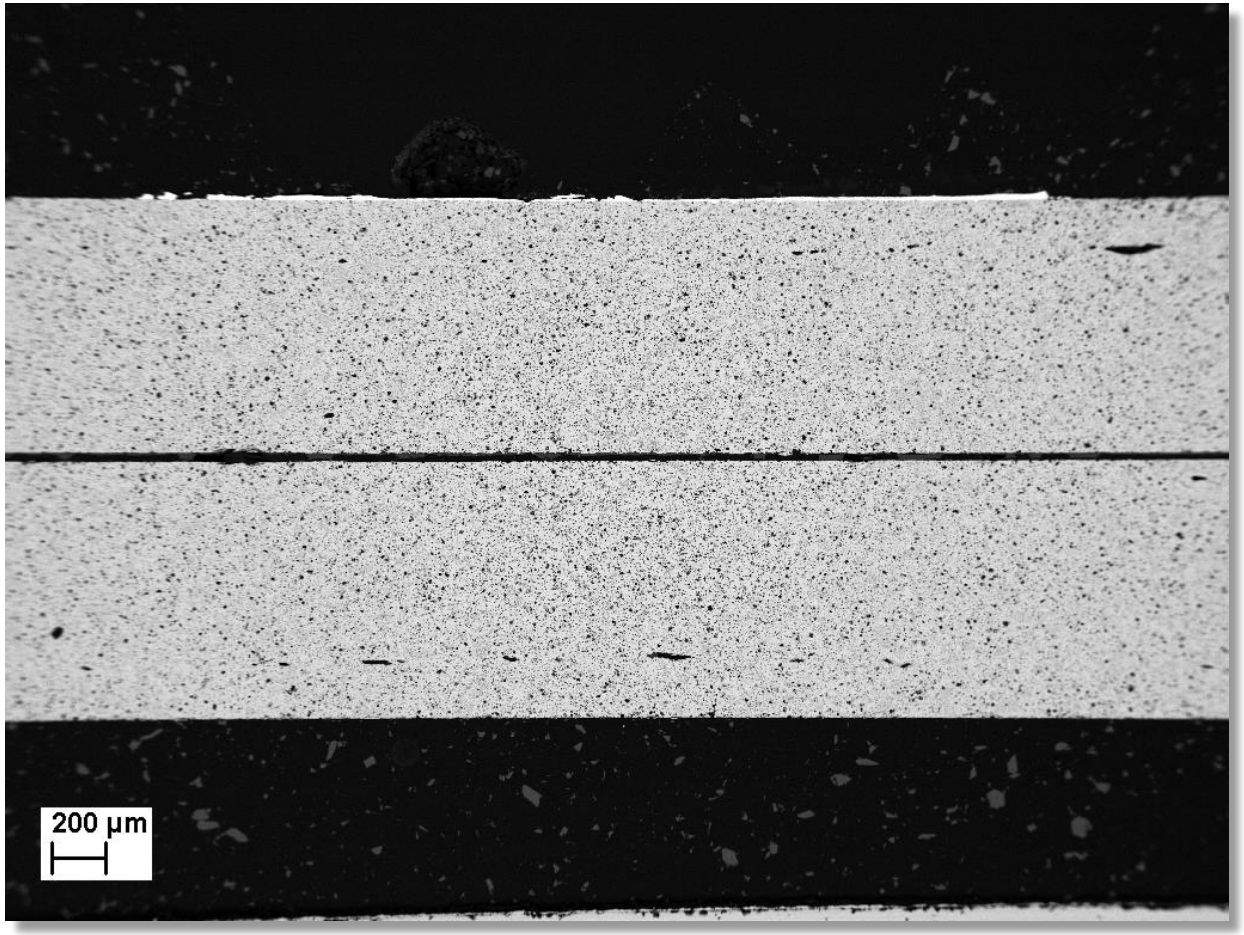
Resintering at lower temperature

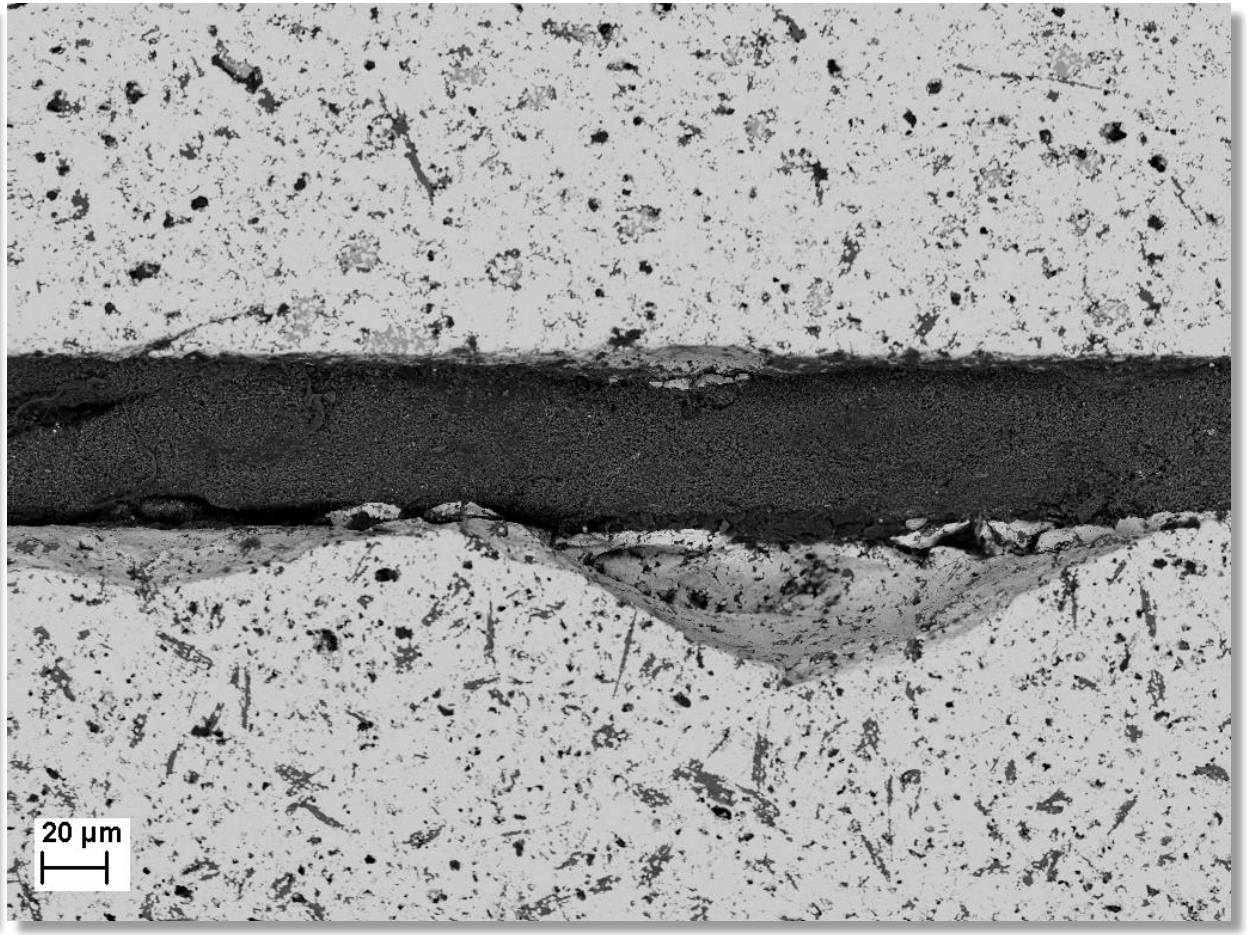
Production of MBO paste and screen printing of layers onto BST pellets



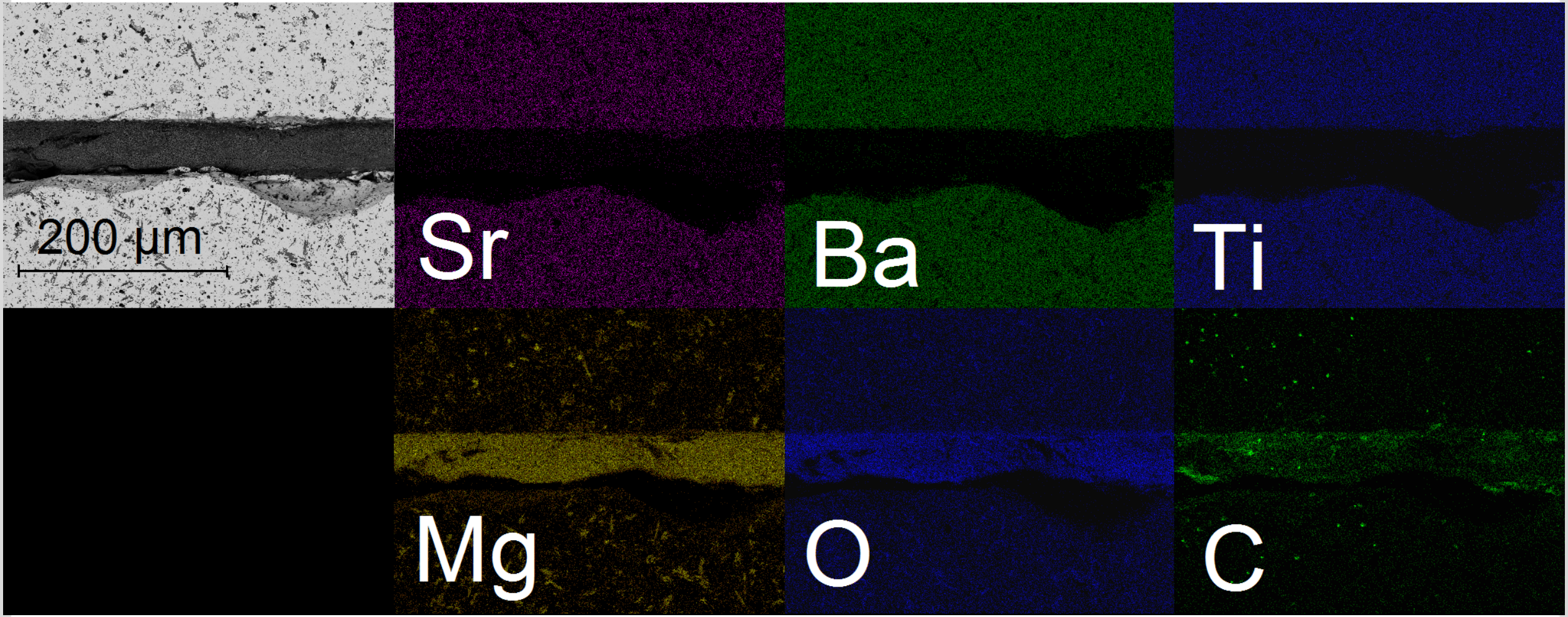


Material results





Material results



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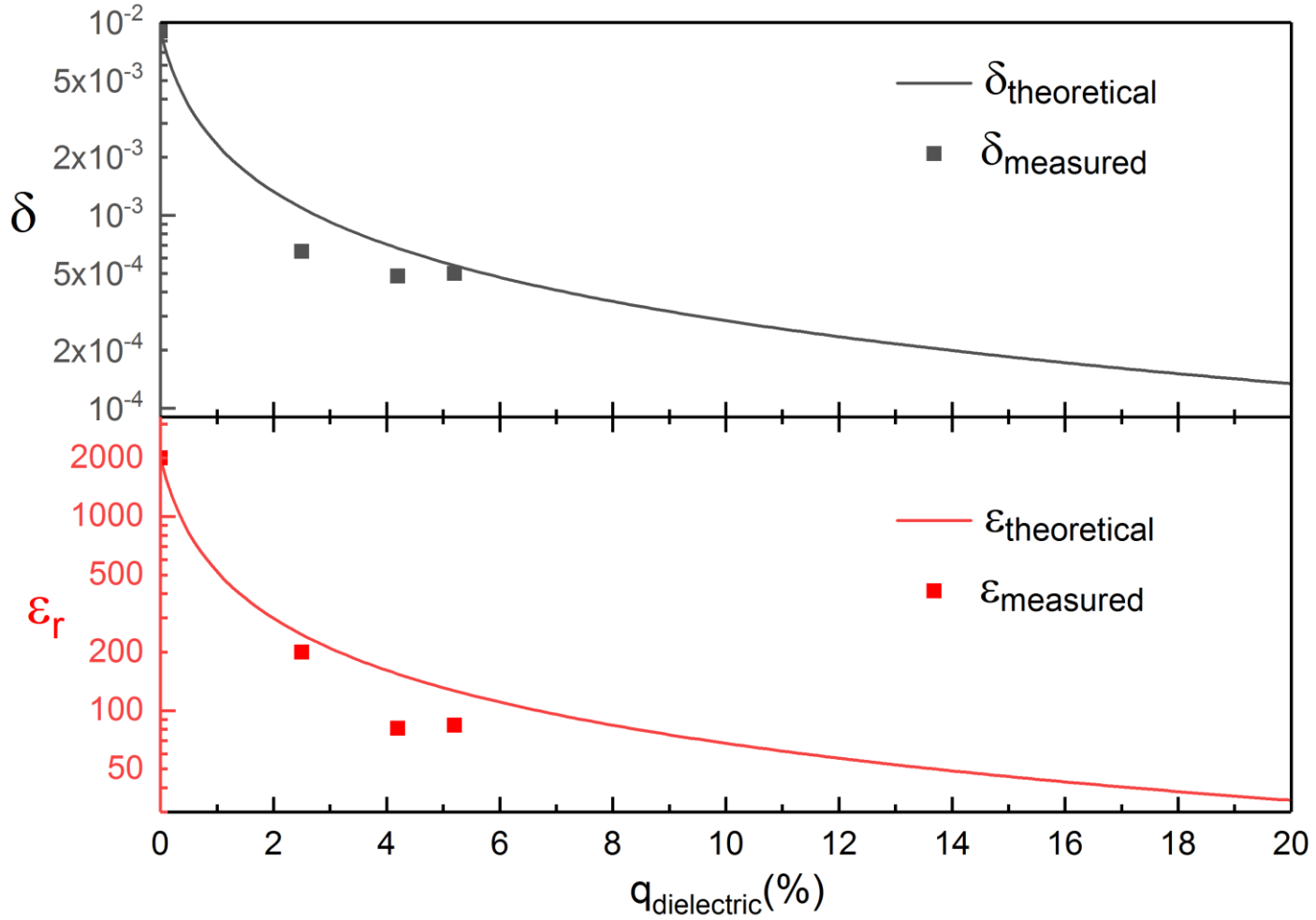
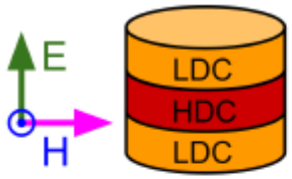
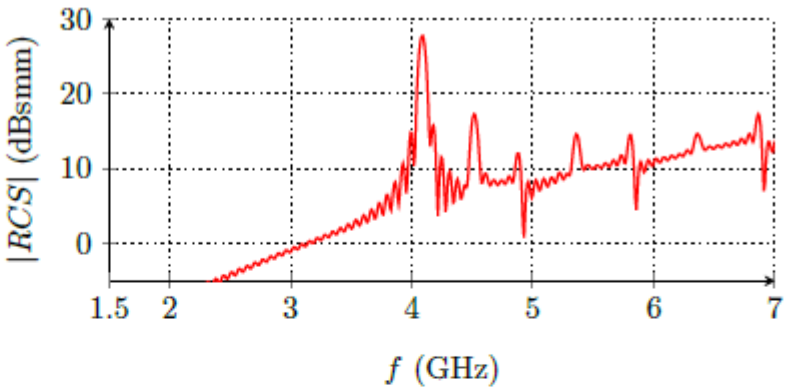
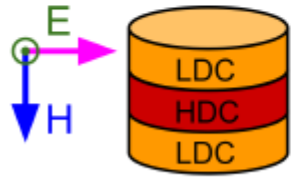
Dielectric results

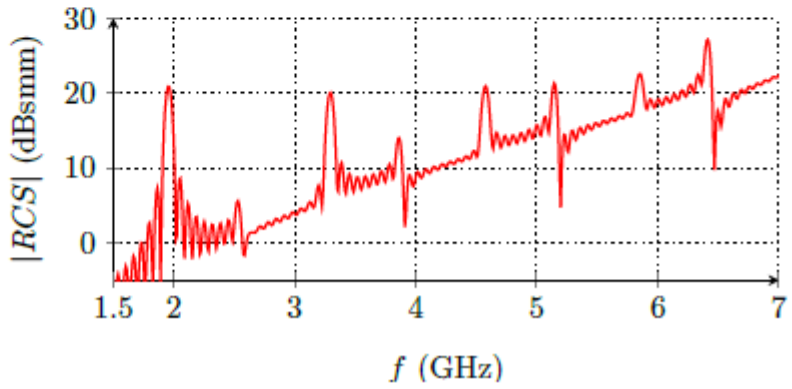


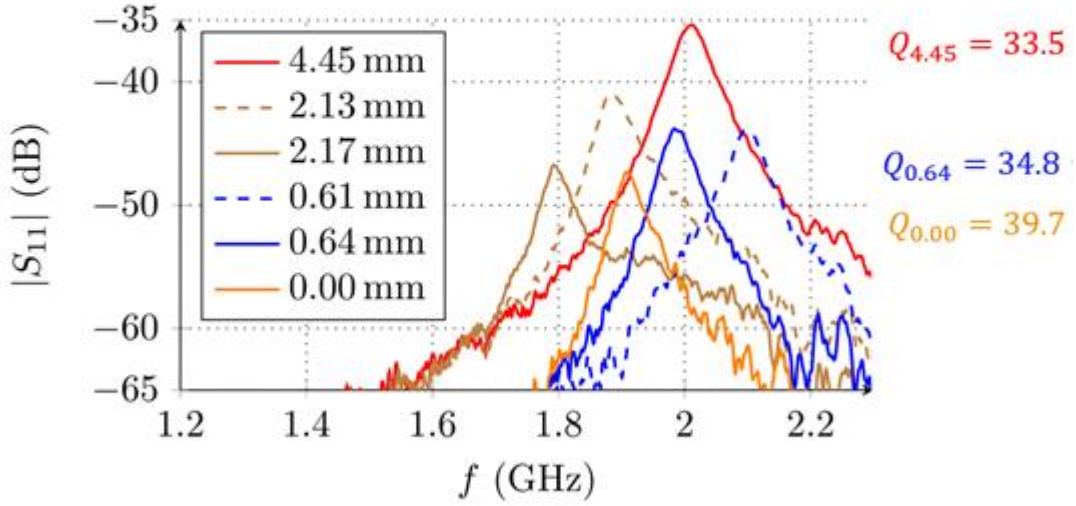
Dielectric results

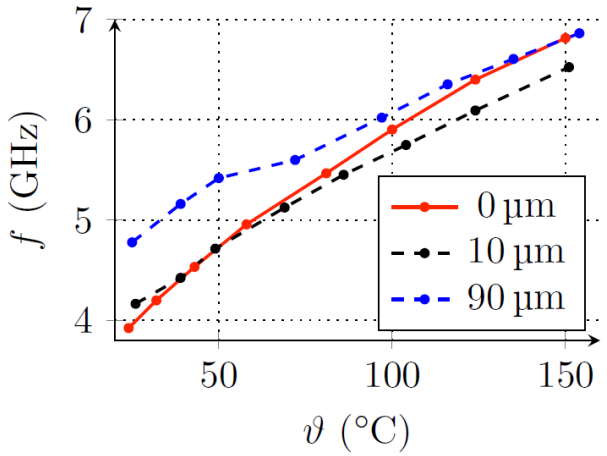












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Thank you for your attention