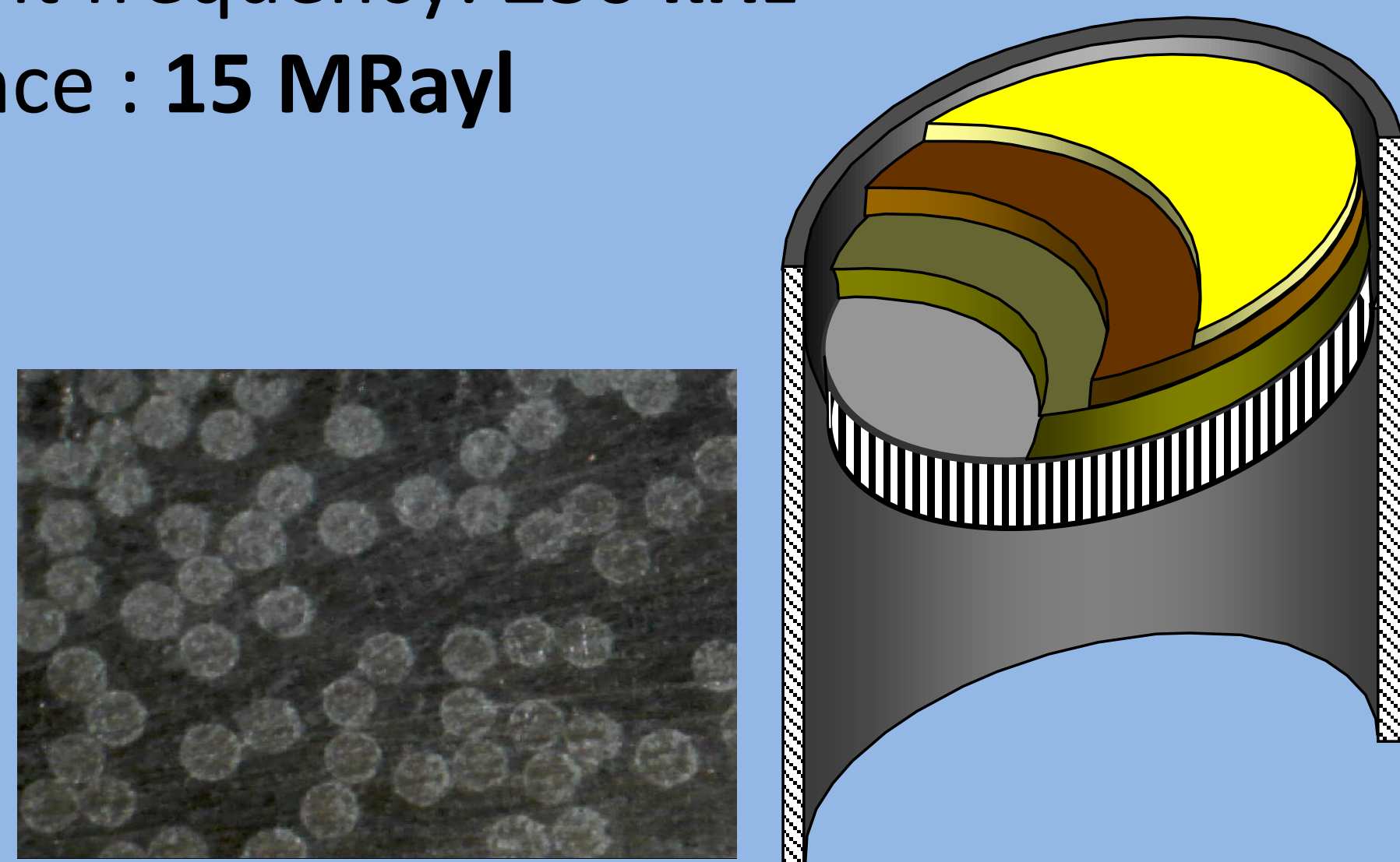


Abstract

This work presents a comparison in terms of sensitivity, bandwidth and signal to noise ratio (SNR) between air-coupled transducers made using two different transduction materials: 1-3 connectivity piezoelectric composites and polypropylene foam ferroelectret films. Center frequency is between 250 and 350 kHz and in both cases transducers are operated in through transmission mode under wideband excitation. Piezocomposite transducers include a stack of impedance matching layers to improve both sensitivity and bandwidth. Sensitivity of piezoelectric transducers is about -25 dB, while the sensitivity of the ferroelectret foam transducers is about -56 dB lower. However, SNR figures are similar for both cases.

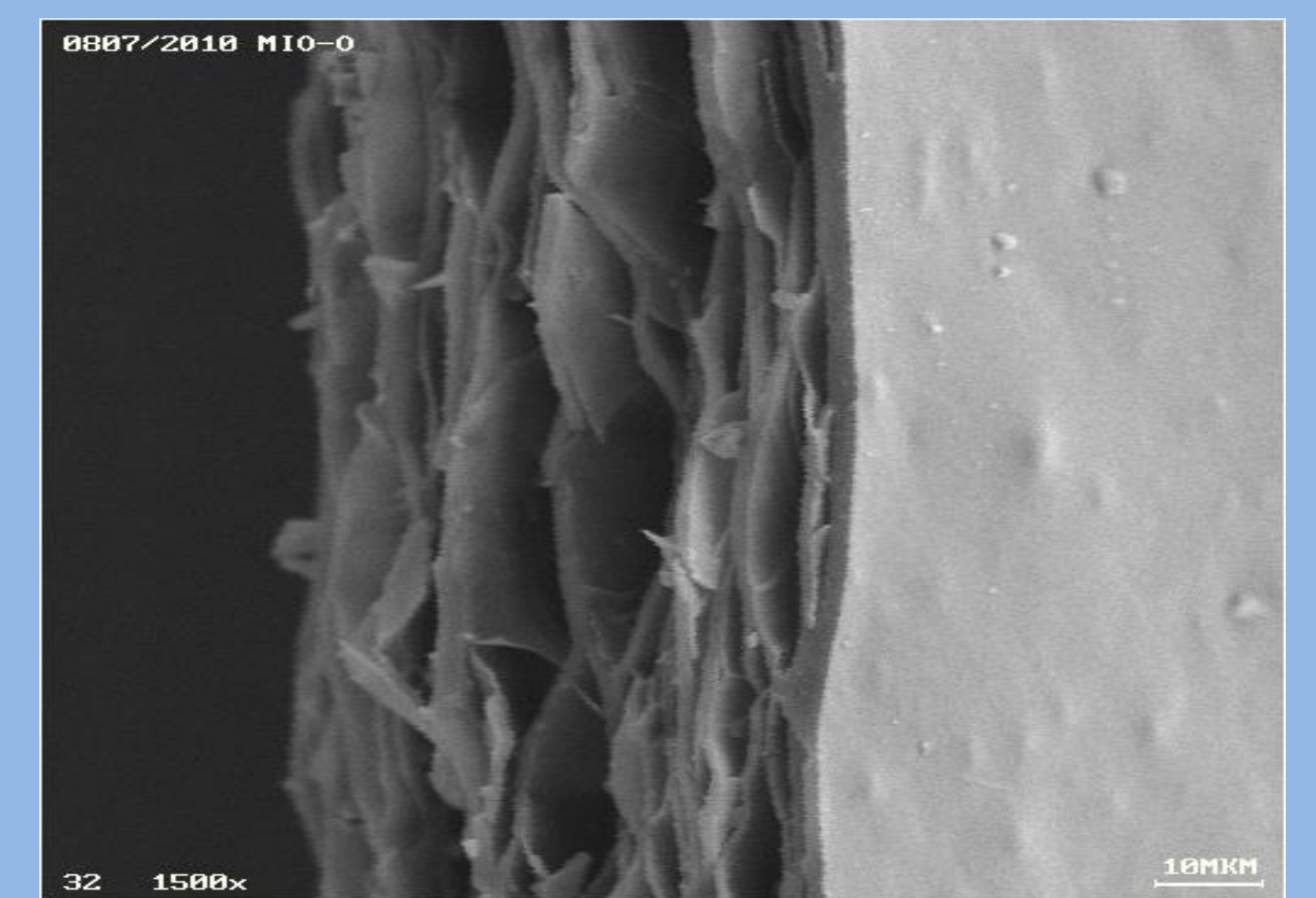
I. 1-3 connectivity piezocomposite transducer

- 200 μm PZT 5H piezoceramic fibers (60% volume fraction) SmartMaterials™
- Thickness resonant frequency: **250 kHz**
- Acoustic impedance : **15 MRayl**
- 25mm diameter
- Matching layers



II. Polypropylene ferroelectret transducer

- Metalized Polypropylene foam
- Thickness resonant frequency: **320 kHz**
- Acoustic impedance : **0.05 MRayl**
- Thickness: **70 μm**
- 15 mm diameter
- Steel backplate



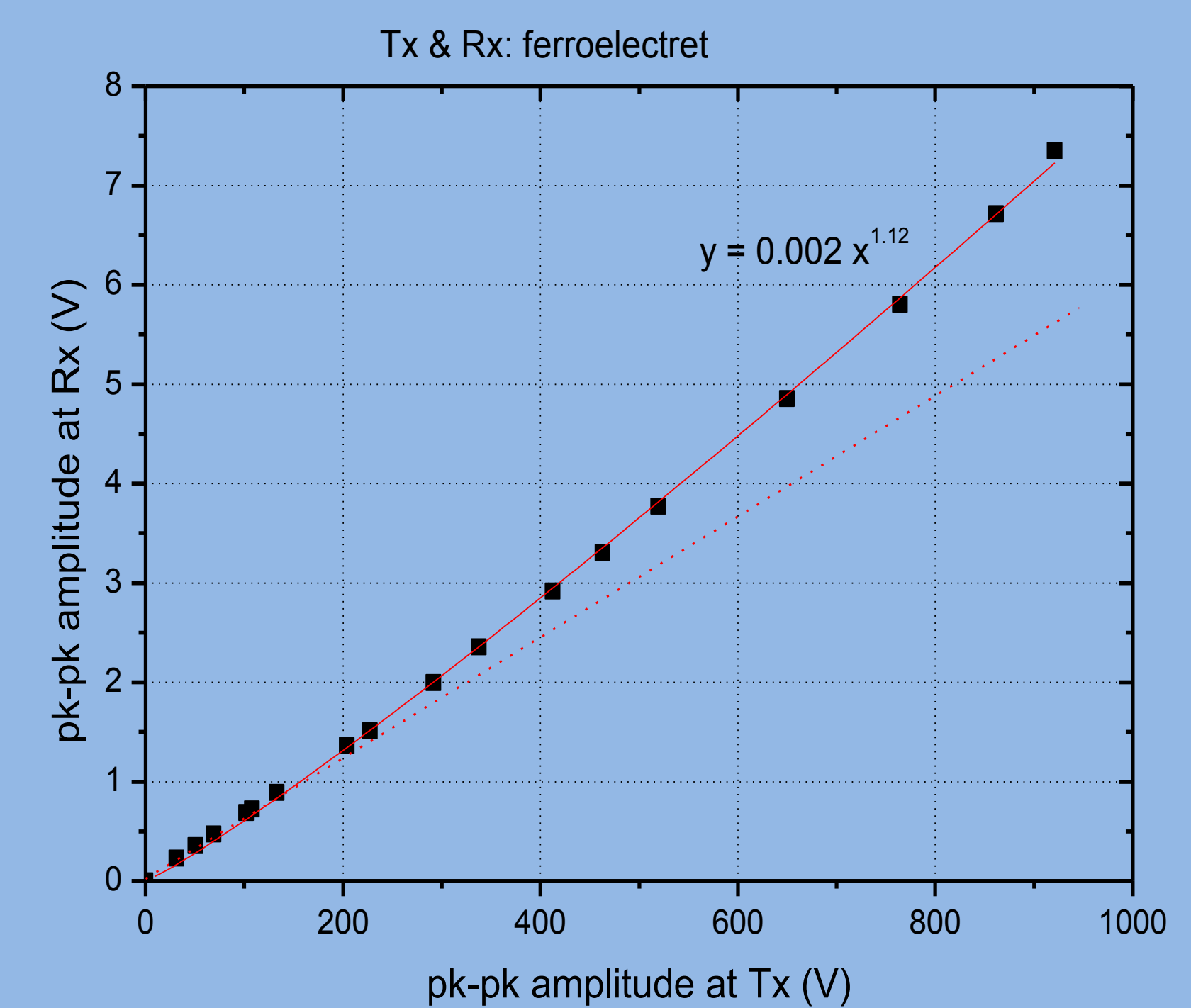
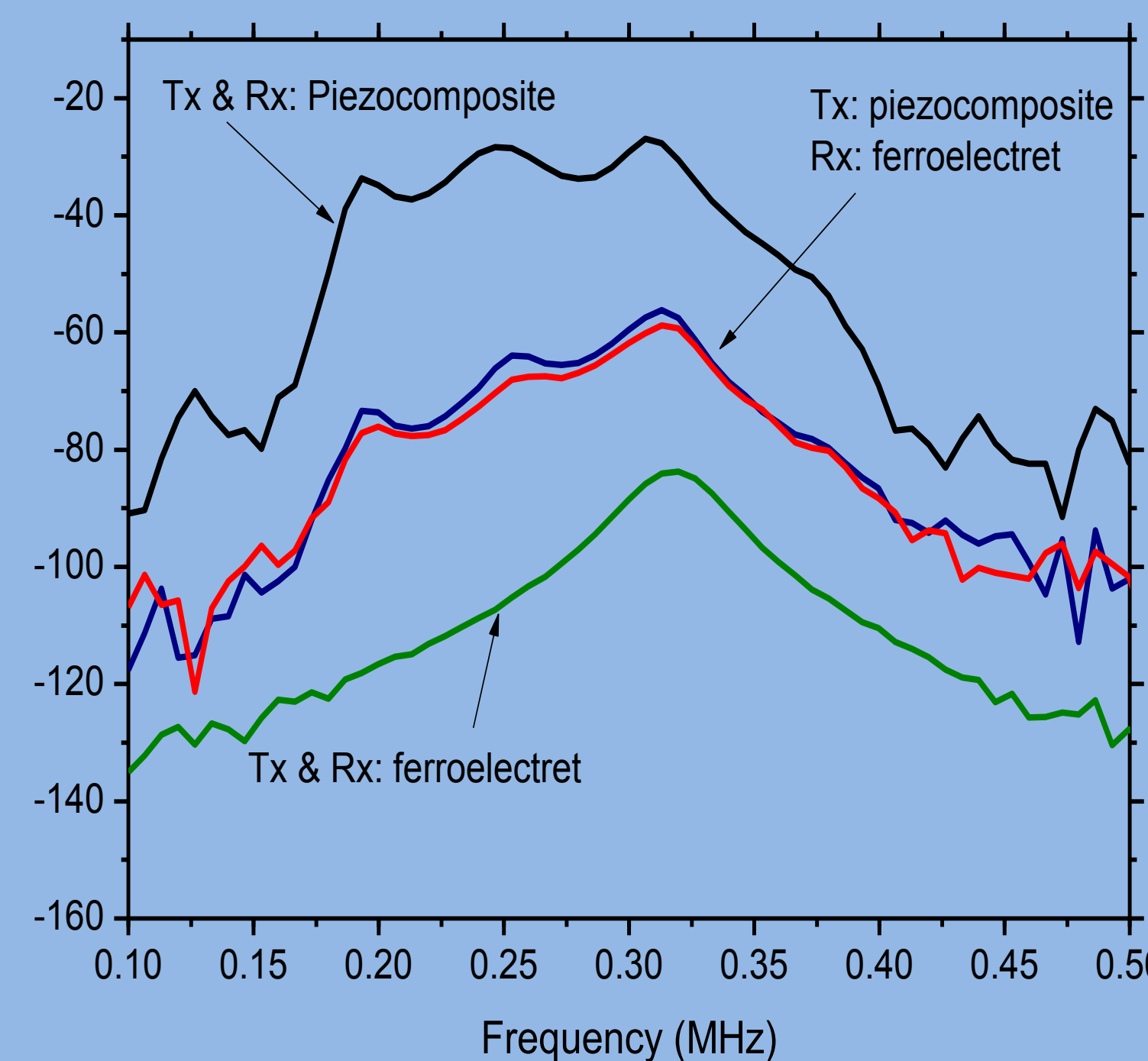
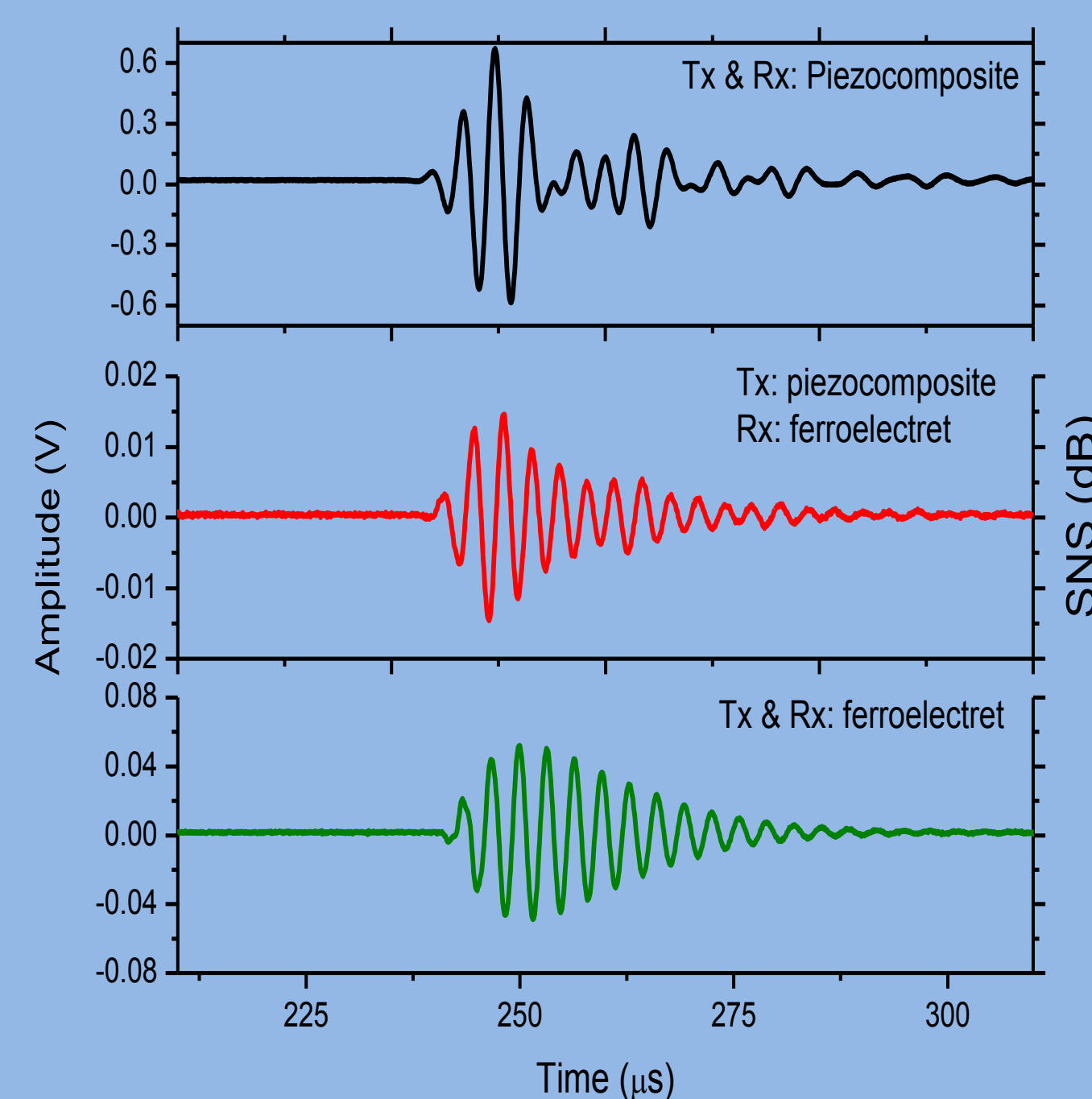
III. Experimental setup

- 30 mm Air gap
- Panametrics 5077 Pulser/Receiver
- Tx: Neg. Square semicycle (100-400V)
- Rx: Amplifier (0-40 dB)
- Digitilization / FFT : Tektronix 5054 DPO

$$SNS (dB) = 20 \log_{10} \left(\frac{|FFT(V_{Rx})|}{|FFT(V_{Tx})|} \right)$$

$$SNS (dB) = 20 \log_{10} \left(\frac{A_{signal}}{A_{noise}} \right)$$

IV. Results



V. Conclusions (Piezocomposites)

- Piezocomposites are optimised for the thickness resonant mode rendering better response and sensibility, better bandwidth and overall better performance.
- Are complex and expensive to produce.
- Because the high mechanical impedance a stack of matching layers are needed.

VI. Conclusions (Ferroelectret foam)

- Cheap and simple to manufacture. Versatile.
- Low impedance. No matching layers needed.
- Low hygroscopicity.
- Low SNS performance. Unsuitable for inspection of materials with a large insertion losses.
- Hybrid systems (Piezocomposite+Ferroelectret) feasible