

Processing and characterization of new 0-3 PZT/LCR/PA composites

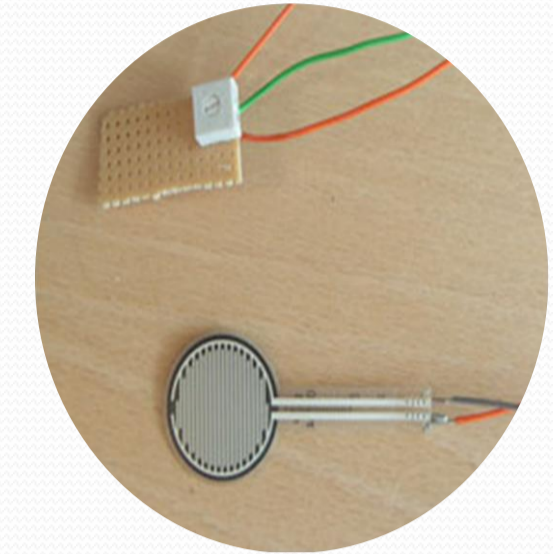
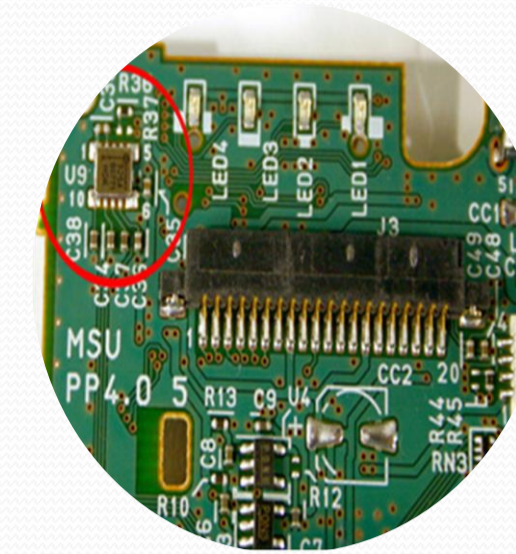
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Smart Materials

Sensors and actuators based on piezoelectric ceramic-polymer composites, so-called smart materials, offer high potential for high tech systems due to:

- Superior overall performance over conventional pure ceramics
- Good elastic compliance and durability
- Great promise for sensing and actuating applications



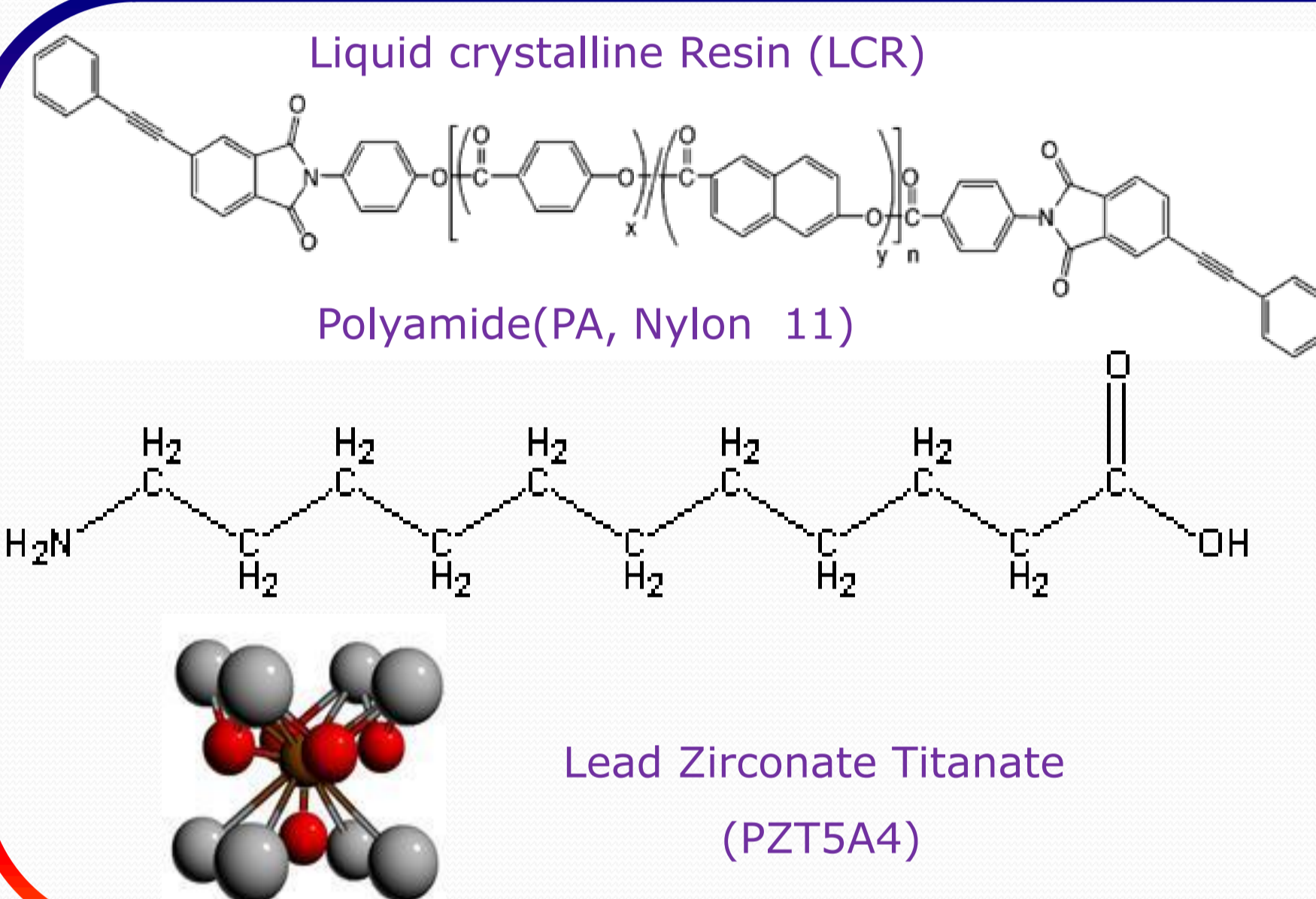
Piezoelectric sensors

Research Goal

Development of a new piezoelectric composite with good ductility and high temperature stability for sensing applications using novel materials based on incorporating polyamide into PZT/LCR composites.

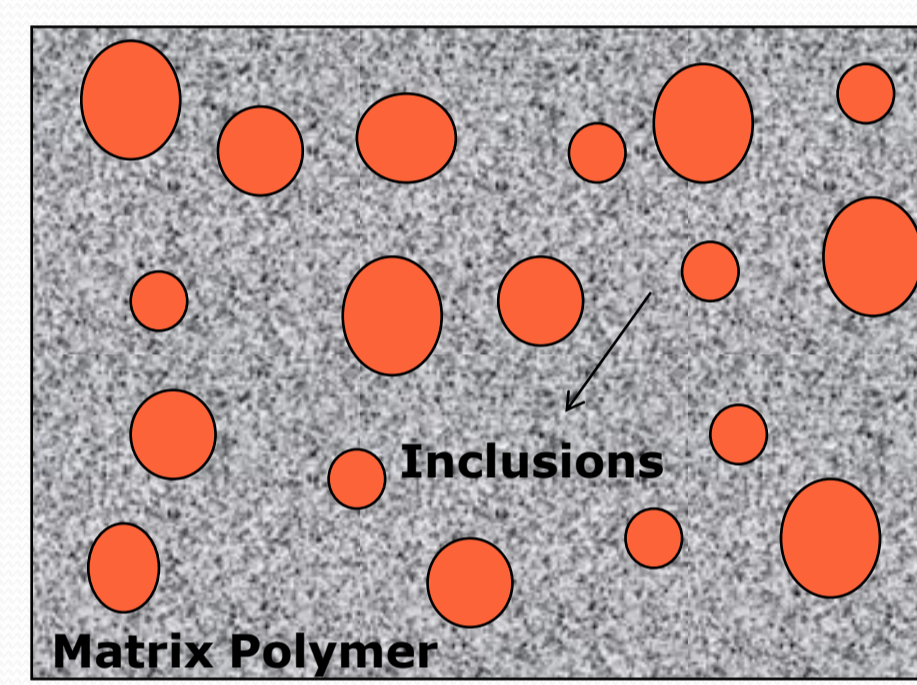
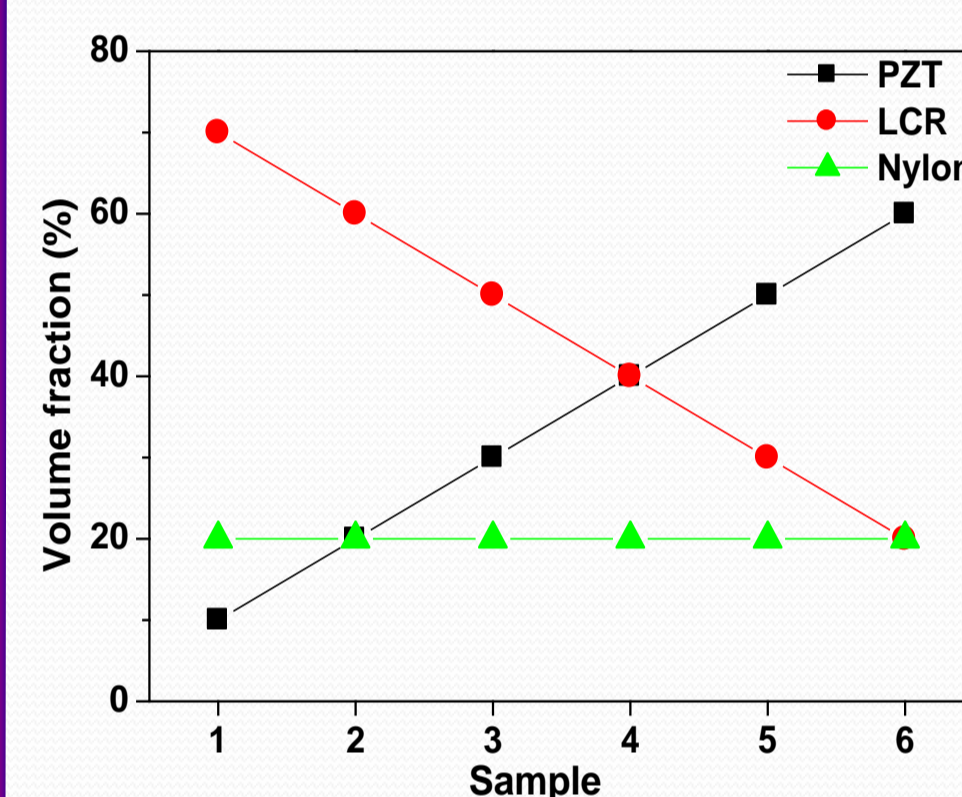
Materials

Composite Fabrication Route

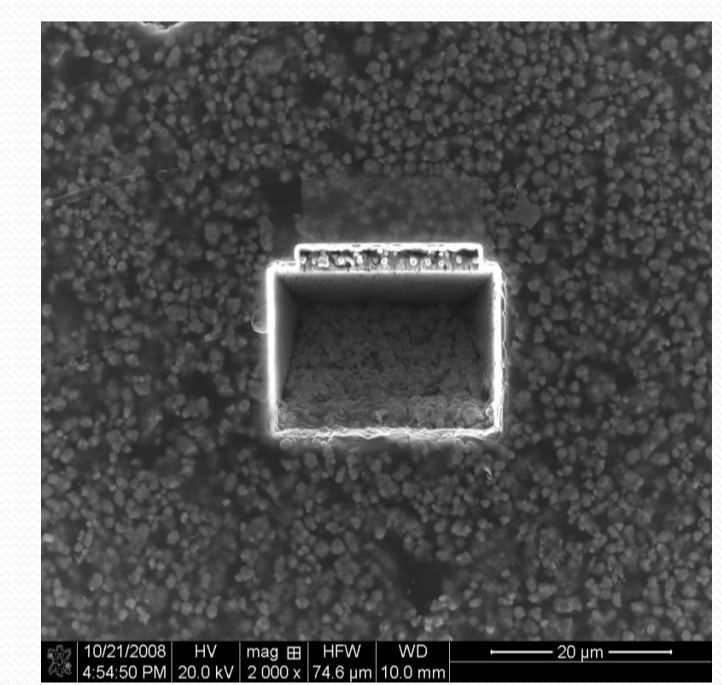


Fabrication

- Optimization of PZT powder
- Composites fabrication: Hot-press method at various volume fractions (ϕ)
- Characterization studies: XRD, Particle size, SEM, C_p , ϵ , $\tan \delta$, d_{33} and g_{33}

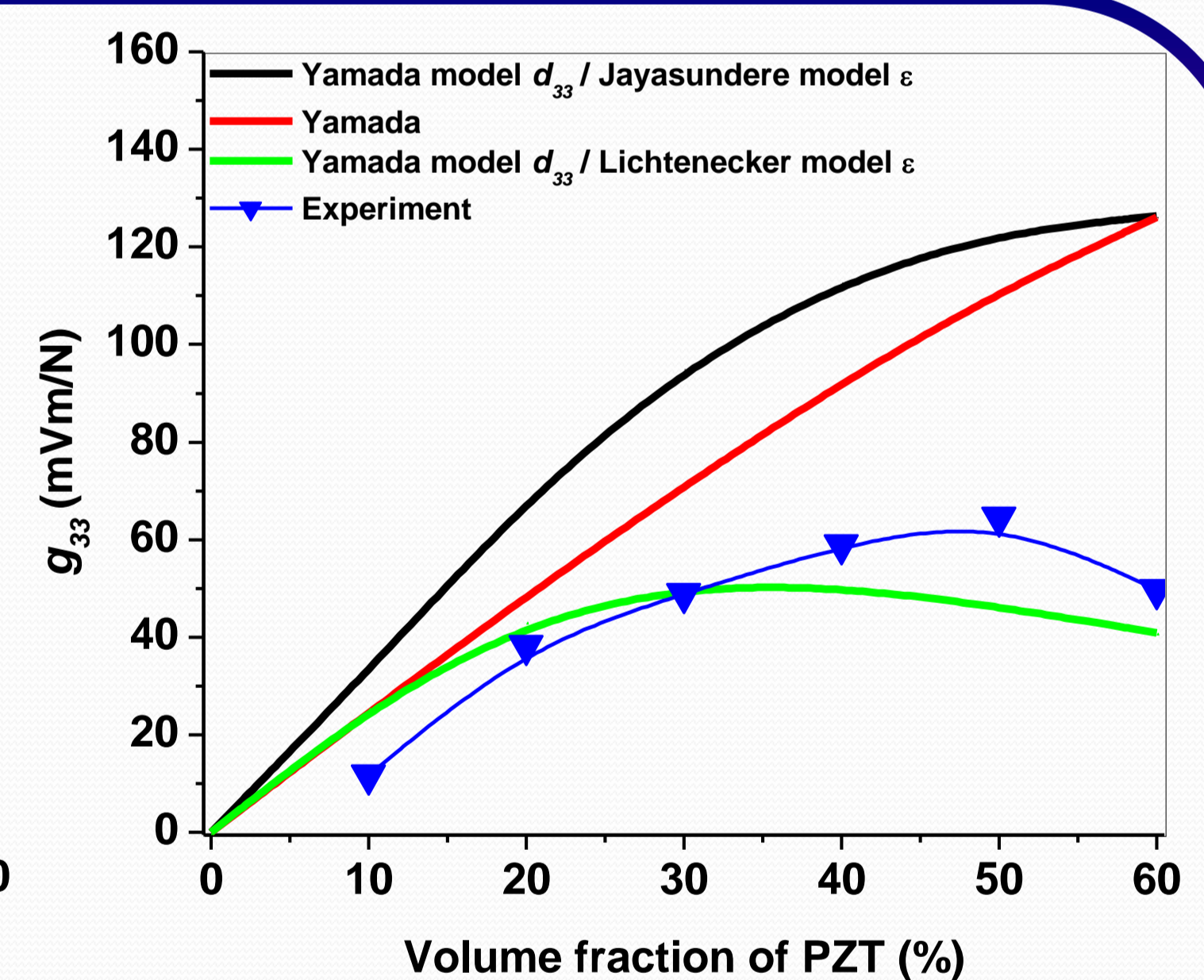
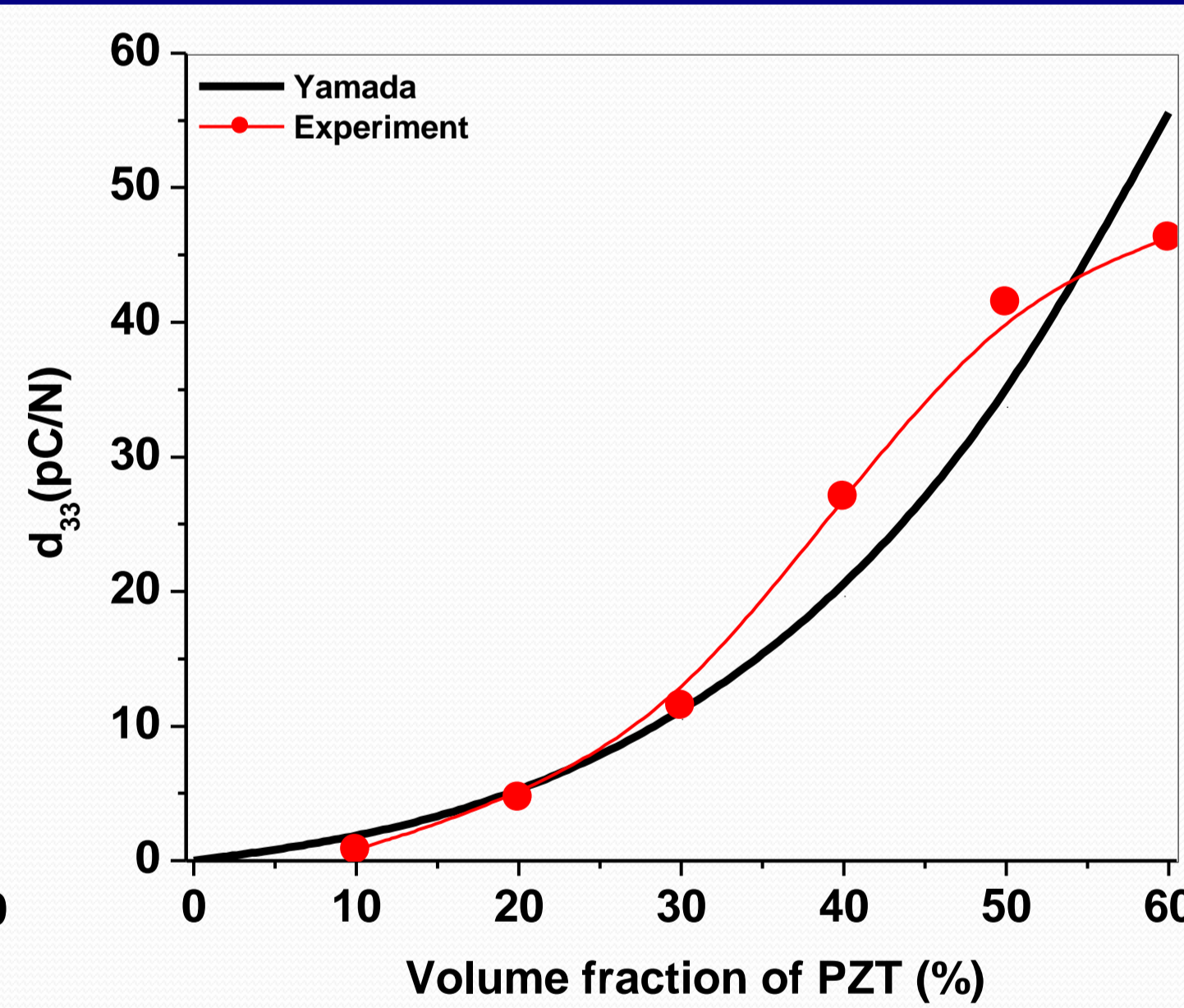
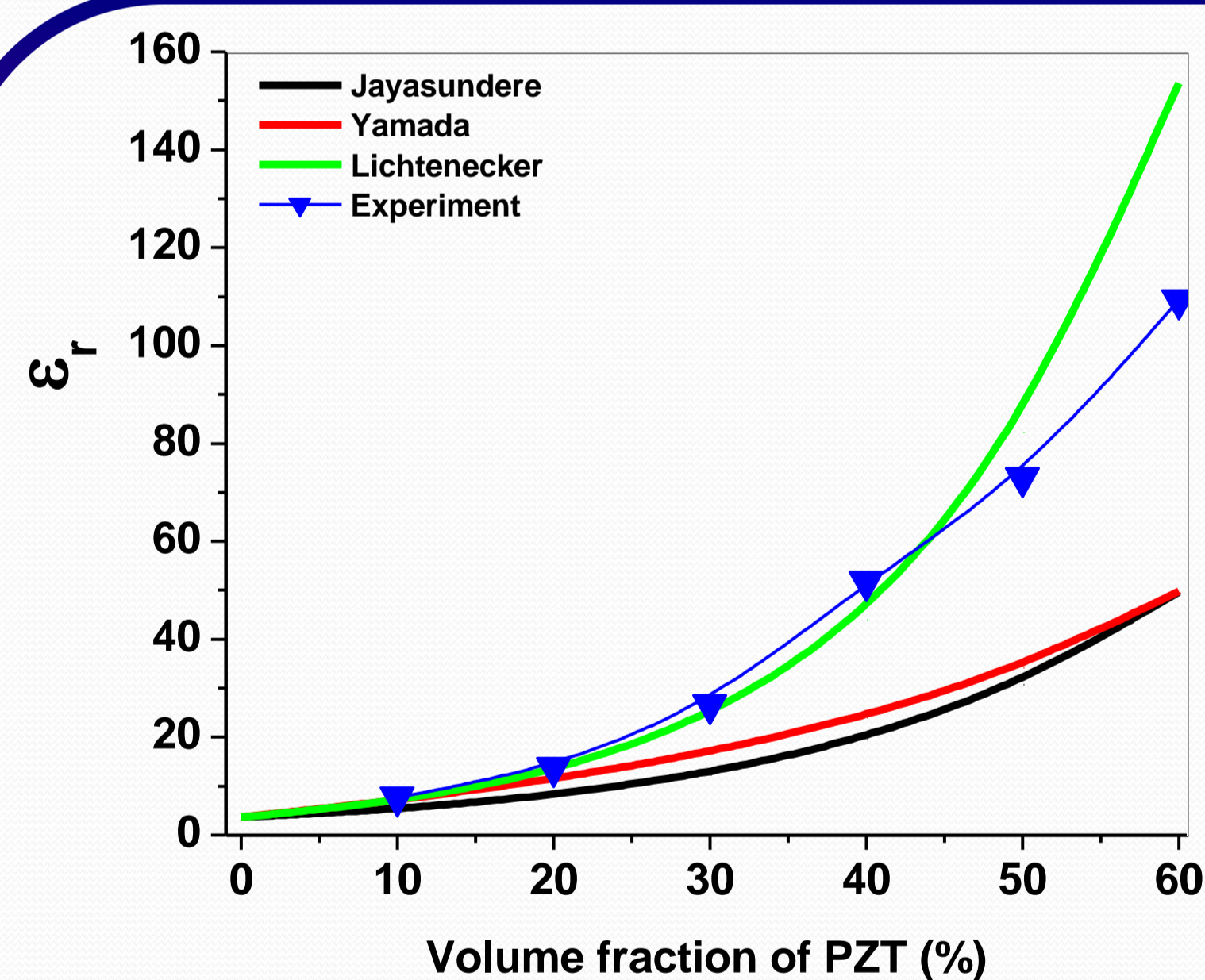


0-3 connectivity



SEM-PZT/LCR/PA composite

Results



- Both the Yamada and Jayasundere models correlate to the measured permittivity values up to 30 volume percent PZT, while Lichtenecker's mixing rule correlates well with the measured values up to 50%.
- Good correlation of measured d_{33} values up to 50 volume percent PZT for the PZT/LCR/PA composites with the Yamada model
- Good correlation with the g_{33} values of the PZT/LCR/PA composites with the values calculated using the Lichtenecker model for dielectric constant and Yamada's model for d_{33} .

Conclusions

The experimental results from ϵ , d_{33} and g_{33} indicates that the new composites have high ϵ , and possess high d_{33} and g_{33} values (0.5 vol% PZT) of about 42 pC/N and 65 mVm/N which is the maximum value for g_{33} in comparison with the other 0-3 composites reported. The experimental data from ϵ follows the same trend as the Yamada, Jayasundere and Lichtenecker model and agree quite well with the Lichtenecker model for PZT volume fractions of up to 50%. While the experimental data from piezoelectric constants agree well with the Yamada model. The above explanation brings to the conclusions that these composites are suitable candidate for both sensors and may even show possibilities as actuators.

Project partners