Piezoelectric flexible materials supported by hierarchically porous graphite for sensor applications

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Piezoelectric materials' capacity to convert mechanical energy into electrical stimulus is nowadays very attractive for sensing and energy harvesting. Piezoelectric composites combine mechanical flexibility and high electromechanical coupling constants, which are desirable in wearable devices; nonetheless, polarisation may be compromised due to the polymer's low dielectric constant and the ceramic phase's discontinuity. While the dielectric discrepancies may be rectified using conductive carbon nanoparticles, the low connection between the piezoelectric phase remains unresolved [1]. Recently developed, highly porous 3D carbon networks are thought to address these concerns [2]. This work will investigate an entirely new concept for designing and fabricating piezoelectric flexible materials using a 3D graphite network loaded with barium titanate and impregnated with a flexible biobased polymer.
Barium titanate particles were synthesised through hydrothermal synthesis at a moderate temperature (200 °C), and the effect of reaction time on the tetragonality of the particles was investigated to optimise this process (conventional and microwave-assisted synthesis). X-ray diffraction and Raman spectroscopy were used to determine the structural phase, while scanning electron microscopy (SEM) was used to evaluate the morphology. The barium titanate particles were impregnated into the graphite network with and without the use of voltage, which is believed to enhance and facilitate the impregnation flux. The final device warranted a chitosan/zein polymer to incorporate the resulting apparatus for flexibility with built-in electrodes for electrical output testing. The graphite network piezoelectric responses, preceding and following impregnation (Figure 1), were tested using Piezoresponse Force Microscopy (PFM) and piezoelectric sensitivity measurements. The structure : property relationship was also evaluated.

References

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Figures

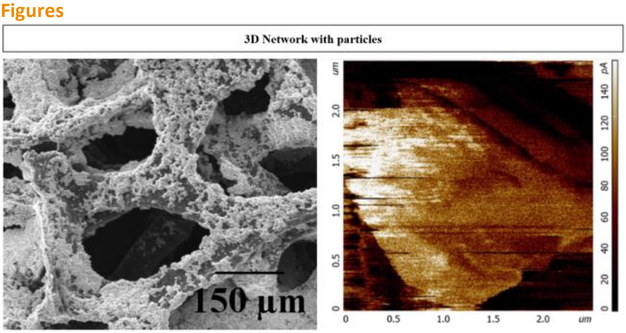

Figure 1: SEM and PFM analysis of the 3D carbon network with particles.