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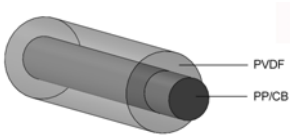
Aim

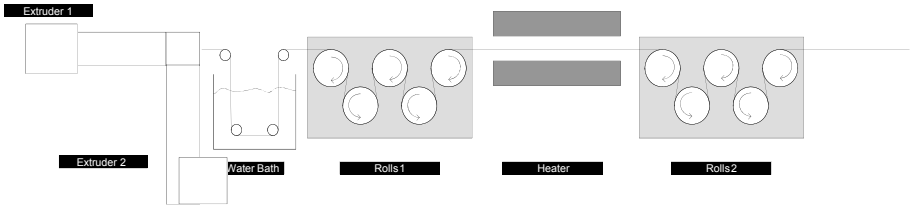
Development of the technology for the production of piezoelectric filaments for application in textile industry, using filament coextrusion.

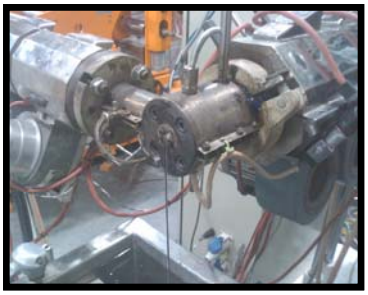
A double-layer filament with coaxial layers was produced. PVDF, the piezoelectric material, was employed for the outer layer, whilst for the conductive inner layer a commercial PP matrix grade with carbon black was used.



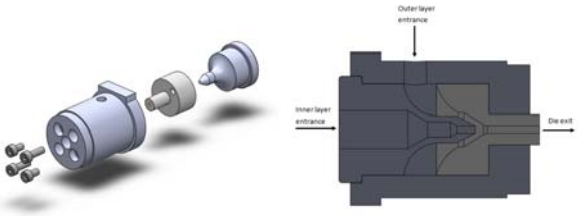
Experimental Work

Monofilament coextrusion line





Coextrusion die

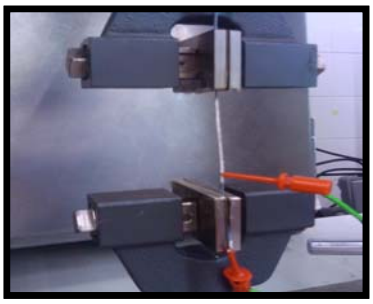


The extruded samples were stretched to ratios up to 6, at temperatures of 80ºC to 120ºC. This enabled the transformation from α-phase to β-phase, the most electroactive phase of PVDF.

The extrusion die was developed to allow an easy adjustment of layer thickness.

Subsequently the filament samples were coated with electrical conductive ink, and poled through the exposure to an high voltage potential between the inner and outer layers, creating the electric field required to activate its piezoelectric properties.

Test Setup



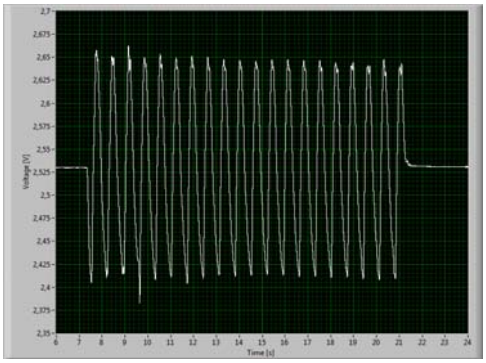
A test to produce traction on the filaments was set up using an universal testing dynamometer. The filaments were pulled with an amplitude of 0.2 mm and the machine was set to a speed of 100 mm/min over 20 cycles.

A charge amplifier was used to condition the output signal and was connected with a data acquisition board. Software for acquisition, processing and display of the signals was developed in Labview.

See here! →

Results

Output signal



Conclusions

- An innovative technique for the production of piezoelectric filaments was proposed;
- A 2 layer coextruded filament was used to produce a piezoelectric filament;
- The scale up production process of piezoelectric filament/tapes is under development.
- Although it was not possible to determine a clear relation between the poling parameters and the output signal, it was possible to obtain a clear output signal, as expected from the mechanical action applied to the filament. The experiment serves as a demonstration for this new type of filament-shaped mechanical sensor.

Acknowledgements

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