

The Energy Harvesting Performance of a Flexible Triboelectric-based Electrospun PTFE/PVDF Fibre

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Abstract: Triboelectric power generator/energy harvester is a focus point for mechanical energy harvesting for smart wearable applications. This paper reports on the fabrication and testing of the energy harvesting performance of PTFE/PVDF fibre prepared by a one-step electrospinning technique. Different concentrations (0, 1, 2, 3 and 4%wt.) of the 1 mm PTFE powder in the electrospun PVDF fibre were investigated. The electrospun fibre was assembled into a nonwoven fabric mat and tested in the vertical standing triboelectric mode by constructing a sandwich structure with electrodes in a book shape assembly. The voltage output from the cyclical compressive pressing test for the added 4%wt. PTFE in the PVDF electrospun fibre was five times greater than for the neat PVDF electrospun fibres. The influence of adding nylon fabric as a triboelectric donor material within the assembly was explored. The output of the 4%wt. PTFE in the PVDF sample was then tested using the constant tapping scheme at different frequencies (3-12 Hz), with and without Nylon fabric. The results show more than 80% increase in the output voltage with the additional nylon fabric included, and the harvester was able to illuminate up to 95 LED lights.

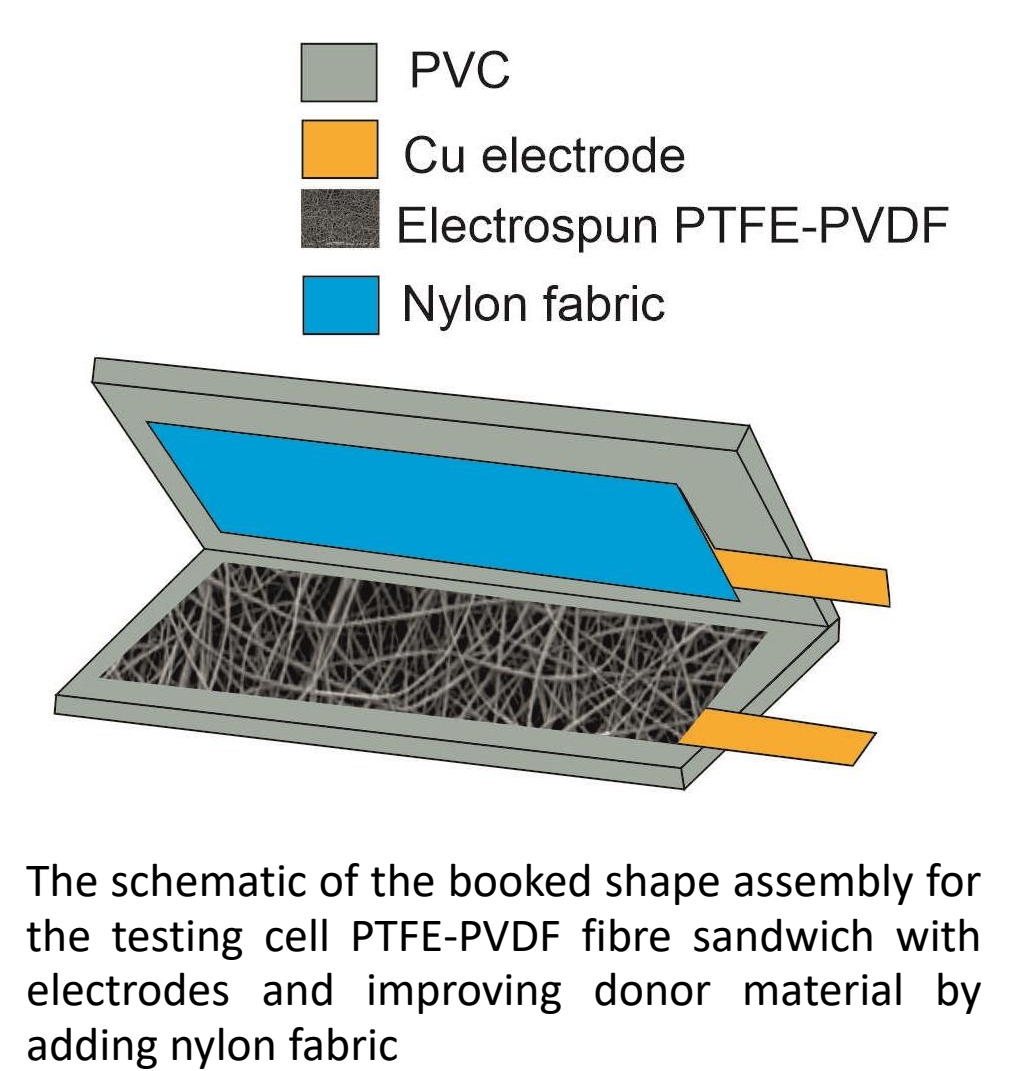
Background and motivation

Triboelectric effect - Donor vs Acceptor

Acceptor	Donor
<ul style="list-style-type: none"> Polytetrafluoroethylene (PTFE) Polydimethylsiloxane (PDMS) Polyvinylidene fluoride (PVDF) Polyvinylchloride (PVC) Kapton Polypropylene (PP) Polystyrene (PS) Natural rubber Epoxy resin 	<ul style="list-style-type: none"> Nylon 6,6, 11 Cellulose Wool Fur Cotton Silk PMMA Silver Copper

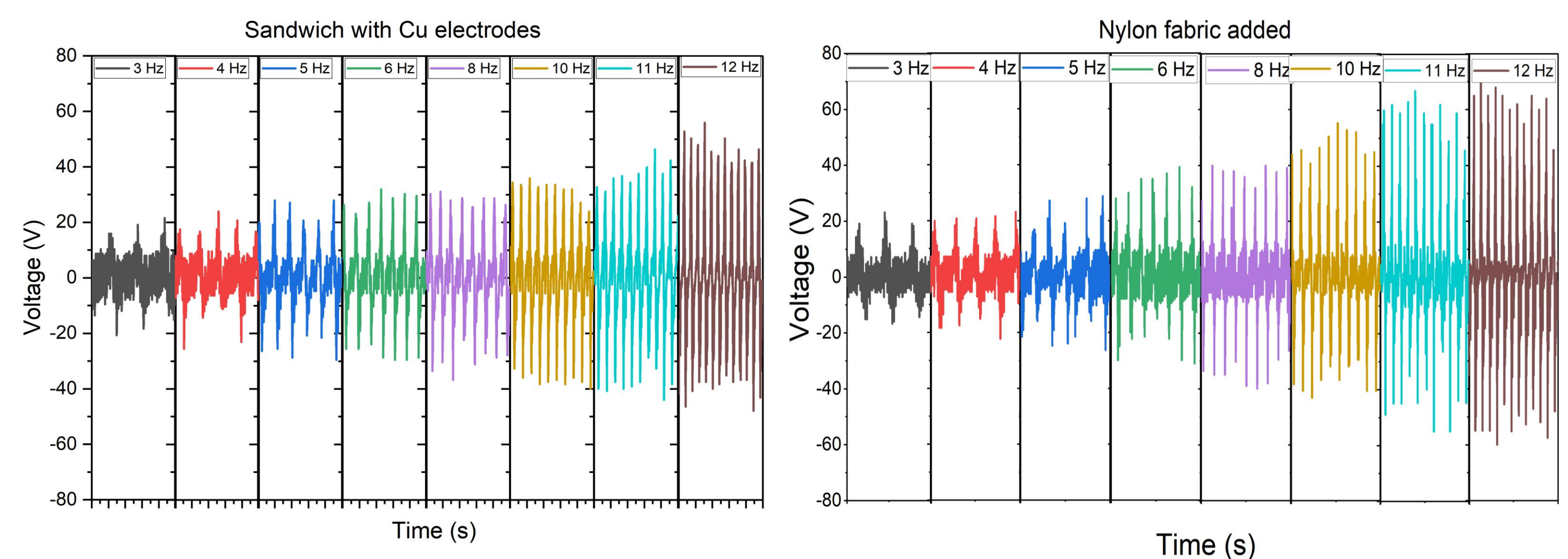
Improve donor material by using Nylon fabric

To enhance the energy harvesting performance of the triboelectric power generator, nylon fabric which belongs to the highest positive in the triboelectric material(donor) list, was introduced to the book-shaped assembly and was tested with the same scheme.



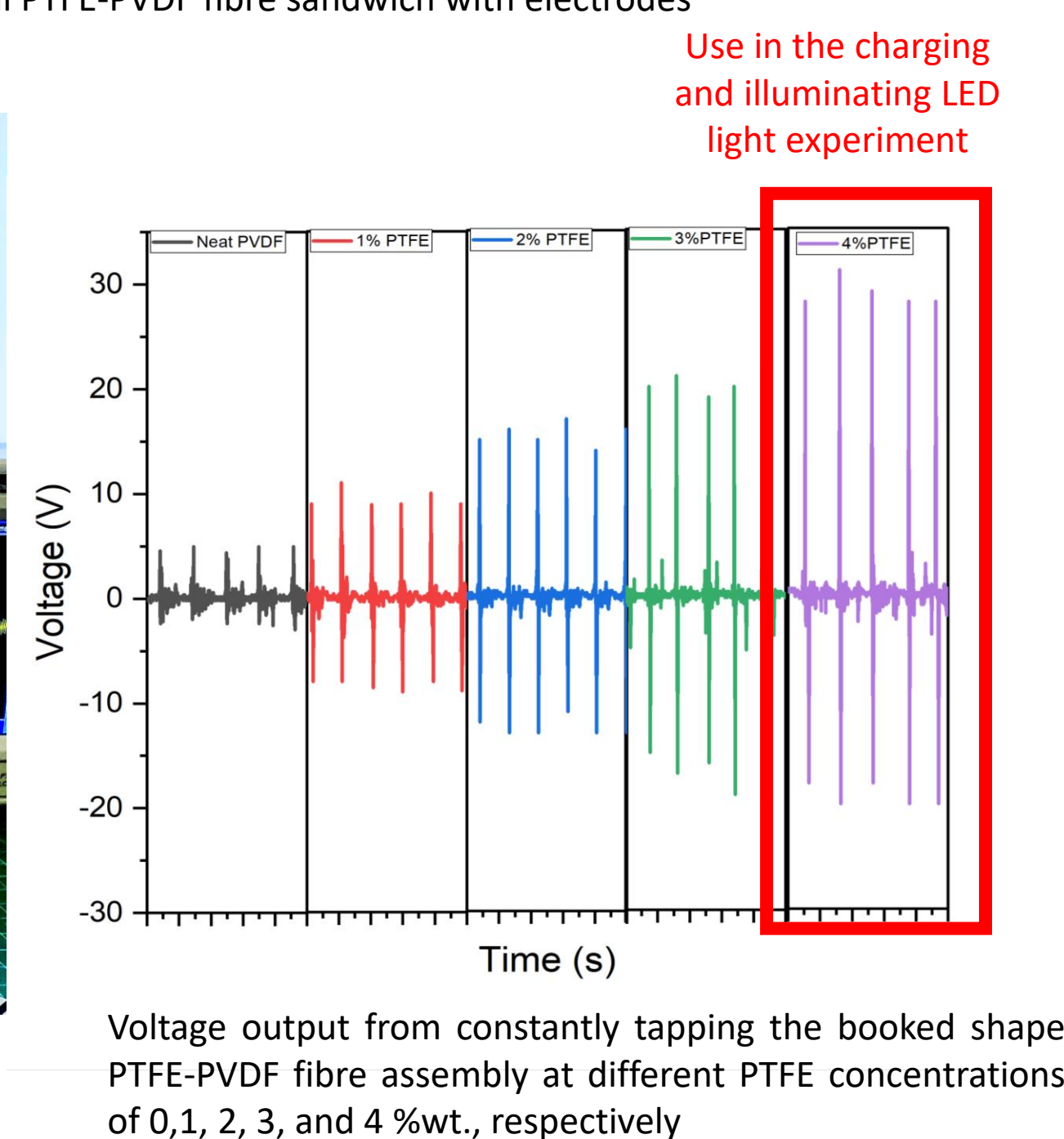
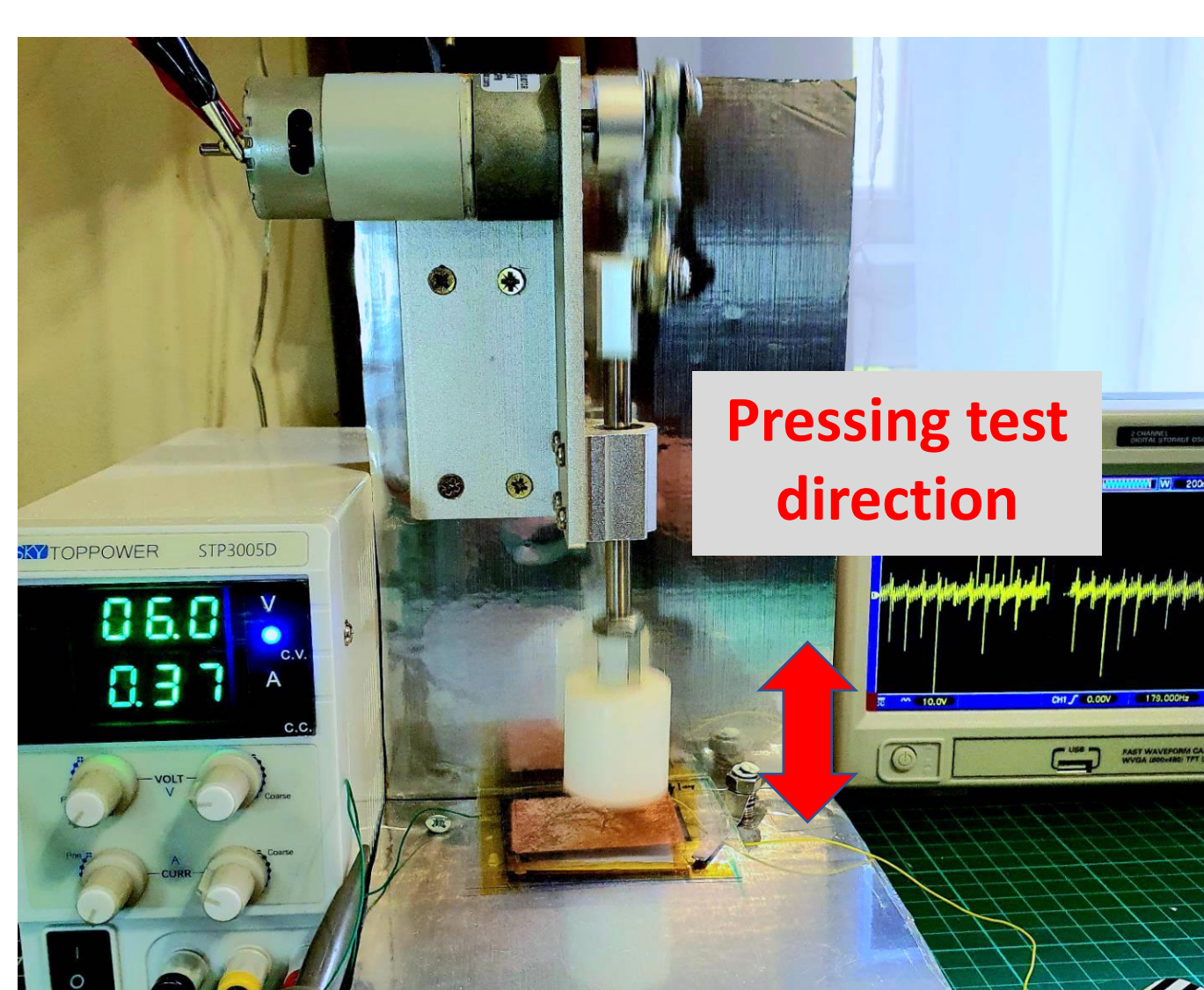
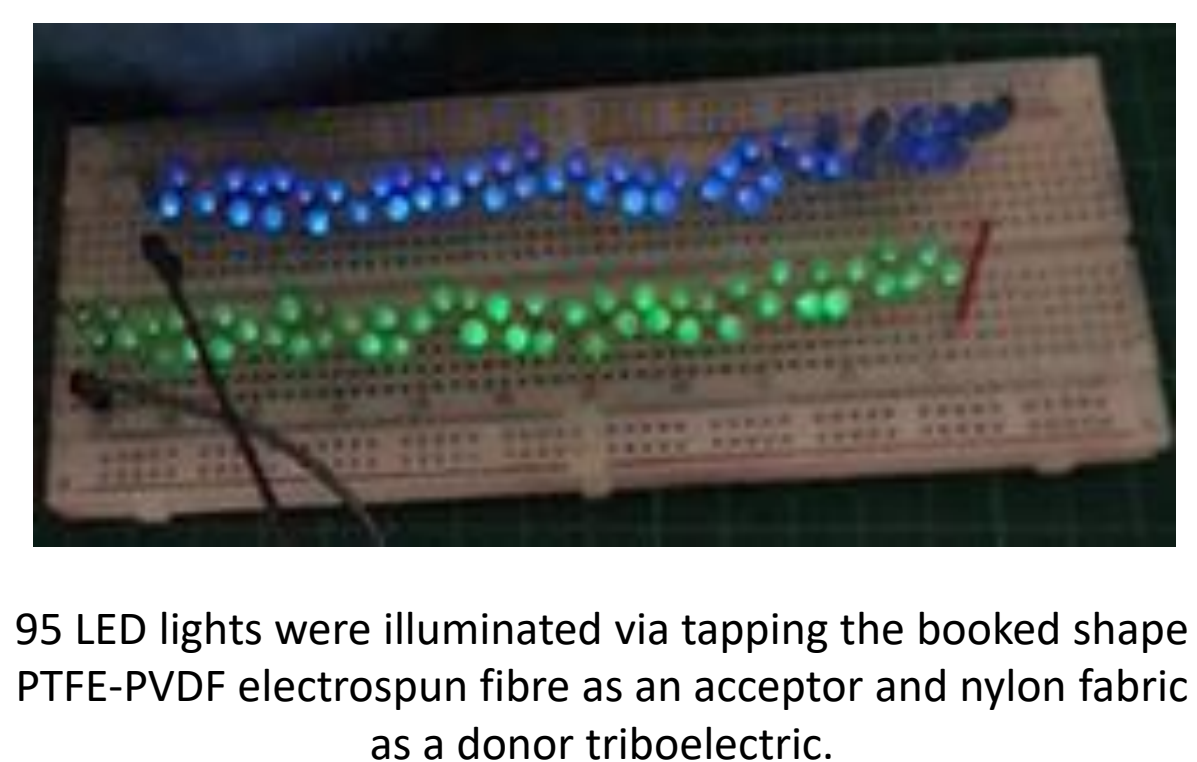
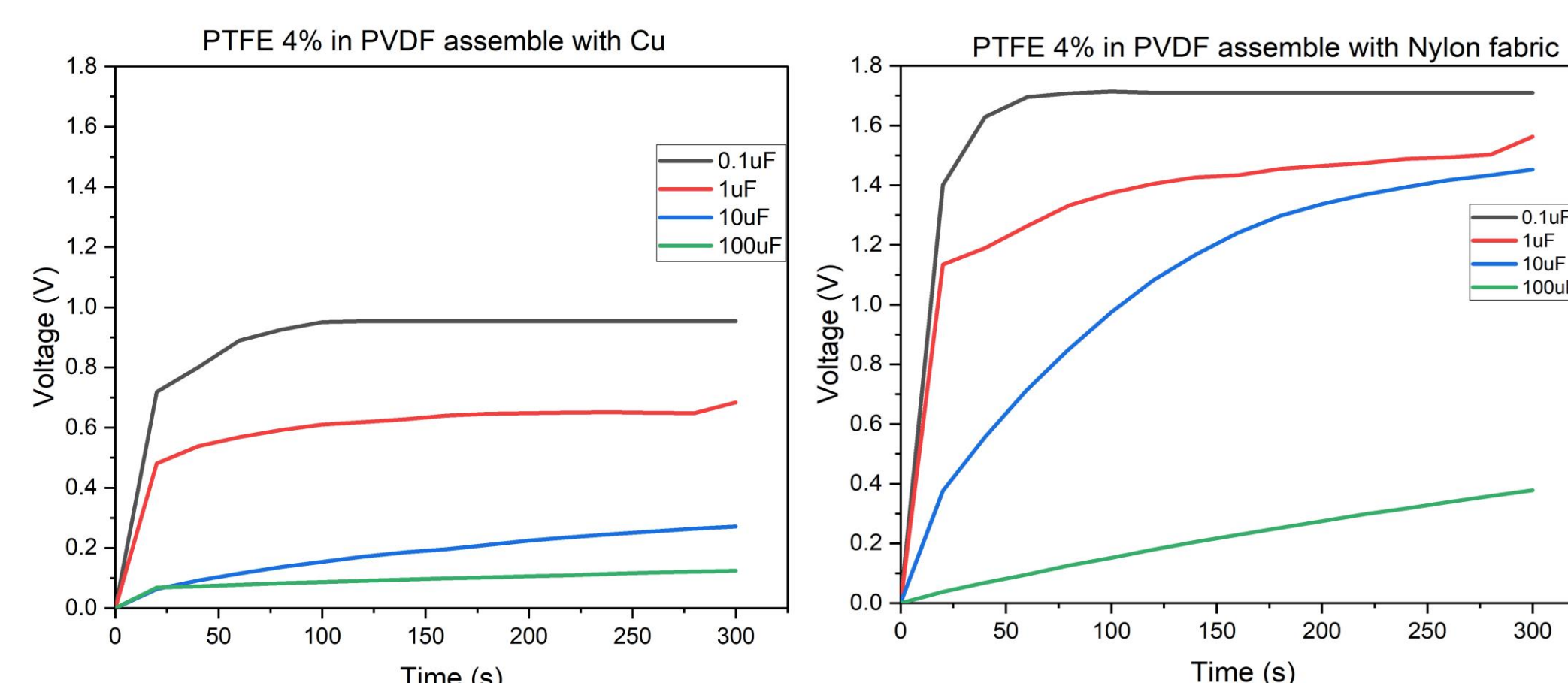
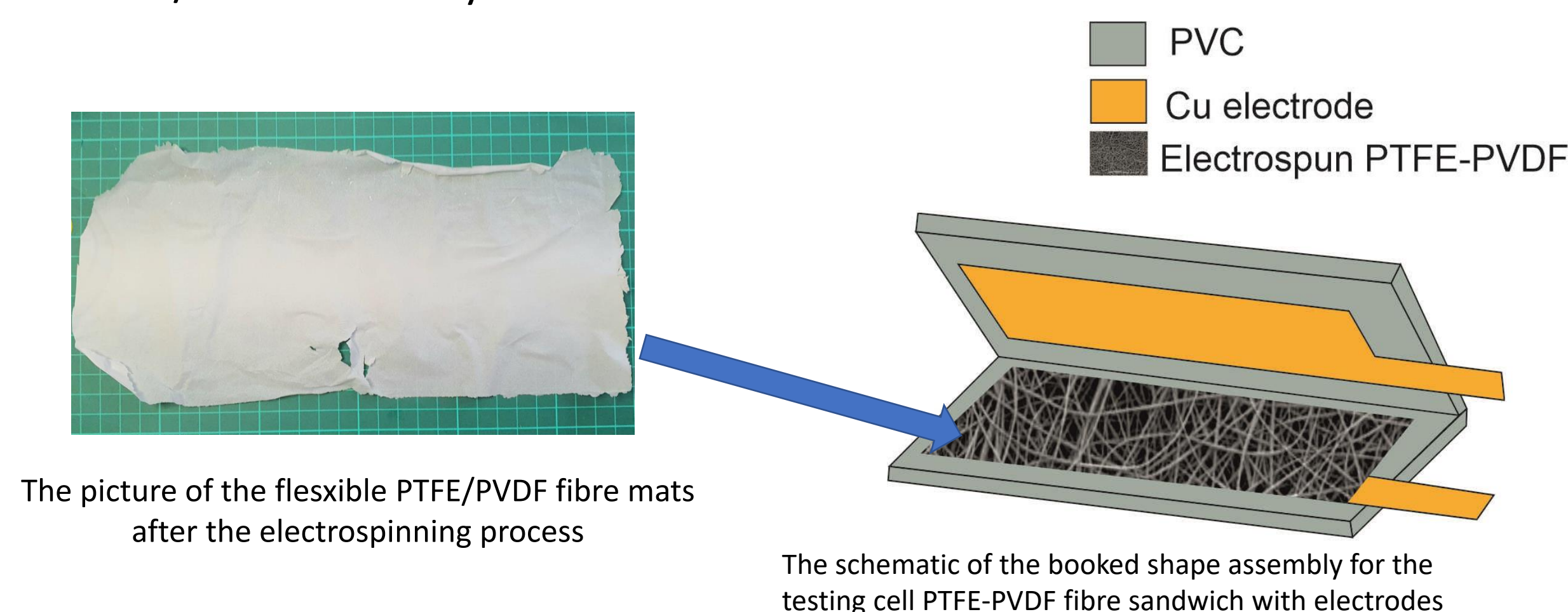
- Enhance triboelectric power generator by increasing the surface area of material via electrospinning technique
- PTFE cannot be electrospun at the room temperature
- PVDF helps PTFE to electrospinning without elimination of the precursor process (One-step electrospinning)
- Demonstrate energy harvesting from the electrospun PTFE/PVDF

The voltage output of the testing cell PTFE-PVDF fibre sandwich with electrodes and book-shaped and Nylon-PTFE/PVDF at the different pressing rates



Experimental procedures

1. The electrospun PTFE/PVDF fibre was prepared by adding 1 micron PTFE powder (0, 1, 2, 3 and 4% wt.) in 18%wt. PVDF in DMF:Acetone (7:3) solution.
2. The electrospun PTFE/PVDF fibre mat was prepared from different concentrations of PTFE (0, 1%, 2%, 3% and 4%) cut into 4x4 cm then assembled and tested in the vertical standing triboelectric mode by constructing a sandwich structure with Cu electrodes using a home-built pressing station.
3. The voltage output was observed during the pressing test for the book shape like PTFE/PVDF assembly.



Conclusion

A flexible PTFE fibre was successfully prepared by a one-step electrospinning process using a PVDF solution as a precursor. The energy harvesting performance was first explored using a vertical contact separation mode triboelectric assembly. The results from the charging experiment and illuminating LED light proved that the electrospun PTFE-PVDF fibre mat could be integrated with the smart textile or wearable device in the future.