Flexible printed graphene electrodes for wearable energy harvesting and sensing triboelectric devices

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Textile-based triboelectric nano-generators (TENGs) represent a promising avenue for self-powered wearable sensing technology [1]. Despite their potential, the challenge lies in removing metallic layers from the devices [2] and developing textile TENGs in adaptable devices using textile-compatible techniques suitable for industrial applications. This study addresses the challenge of developing highly efficient TENGs for self-powered wearable sensing technology by incorporating printed graphene electrodes with shear exfoliate nanoplatelets [3] combined with polydimethylsiloxane (PDMS), and the textile itself as a triboelectric pair. To enhance the device, a flexible electrode was engineered through the planarization of the textile employing polyurethane adhesive [4]. The planarized textile TENGs exhibited a significant performance improvement compared to non-planarized devices, achieving a power density of 3.08 μW/cm^2 [5]. Our research involved testing different graphene solution-based deposition methods, showcasing the versatility and efficacy of the chosen approach. By increasing the TENG contact area, we observed a notable enhancement in power output, resulting in an effective power exceeding 60 μW when using four parallel devices. Crucially, the flexible TENGs demonstrated stable output performance even under substantial deformation, highlighting their resilience and flexibility. Moreover, these devices proved highly sensitive to movement, underscoring their potential as wearable sensors for monitoring biomechanical movements. The key contribution of this research lies in seamlessly integrating self-powered wearable sensing technology into textiles, providing a flexible and industrially suitable approach using various graphene solution-based deposition techniques.

References

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Figures

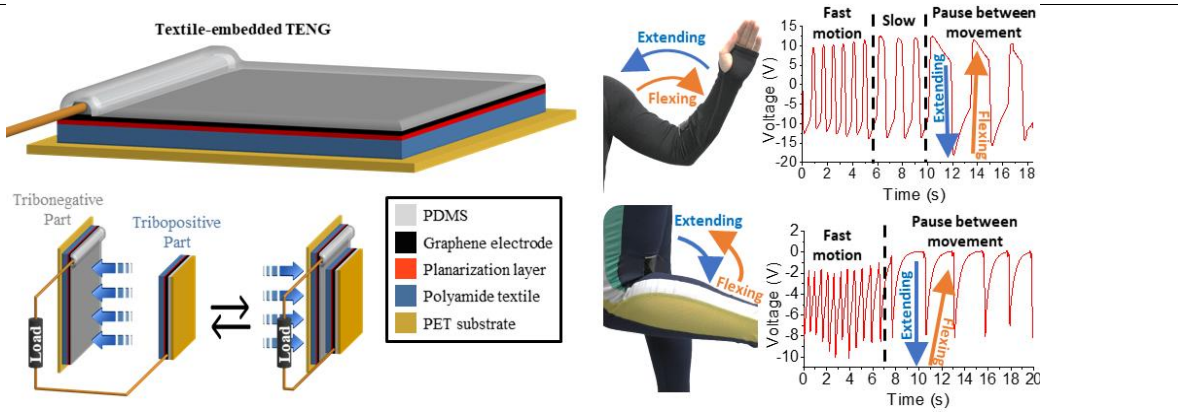

Figure 1: TENG layer scheme showing PDMS vs Textile as triboelectric pair (left) and different motion characteristic sensing signals using single electrode PDMS triboelectric sensors (right).