香港科技大學
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# Ultrastrong Porous GP Nano-Membranes

HKUST

## Background

This invention is of the fabrication of robust multifunctional porous polymer nanofilms-GP membrane. Versatile, freestanding, and ultrastrong GP membranes, constructed from ultrahigh molecular weight polyethylene (UHMWPE), and endowed with a myriad of functionalities, are fabricated using a scalable fabrication process. The nascent GP membranes with nanometer-thicknesses are microporous and hydrophobic and highly flexible with super-high tensile strengths and high ductility; the in-plane specific tensile strengths of the film are about 25 times of that of stainless steel and the ductility of the film is up to 70%. For example, a 5-mm-wide film with thicknesses of 50 nm can withstand tensile loads up to 35 grams-force. The nanofilms can be readily modified by pore surface coating, pore-filling or film surface coating, rendering the films to exhibit adjustable hydrophilicity/hydrophobicity, chemical versatility, and electrical or thermal conductivity.

## Marketing Opportunity

Microporous polymer nanofilms with their intrinsic chemical diversity, lightness, and conformational versatility are enabler materials for technological breakthroughs of existing applications, and for the creation of unknown applications. Current technologies such as biomedical, environmental and energy can benefit tremendously through the use of robust GP membranes. For example, the breathable GP membranes may replace traditional wound-healing dressing by acting to simultaneously heal, sense and suture; the GP membranes can act as in-visible filters/and or catalyst supports for air purification and ultra-fast water desalination; the GP membranes can also be used as electrode/separator assemblies for ultrahigh energy density capacitors, transparent and flexible rechargeable batteries; conductive GP membranes can be used as wave-materials in selective noise cancellation applications or in the design of super-high clarity speakers and microphones. Here we demonstrate the versatility of our GP membranes through their applications as sports fatigue sensors, wound healing films, gesture sensors, nano-vibration films for high-sound clarity speaker designs, and separators in super-high-flux water desalinations.

## Highlight of the Technology

- Superstrong (up to 1400 MPa), Highly stiff (up to 15 GPa), and excellent ductility (up to 70%);
- Optically highly transparent with optical transmittance ~ 98% in the visible light range;
- Microporous with high-porosity (~50%) and super hydrophobicity (contact angle $\approx 140°$) but can be adjustable;

- Ultralow bending energy ( $\sim 10^{-12} J$), far below the human skin's ( $\sim 10^{-10} J$) for full conformability.
- Bacteria-proof and breathable;
- Low cost and easy to fabricate.

## Figures