

Highly durable direct-current power generation in polarity-controlled and soft triggered rotational tribo electric nanogenerator



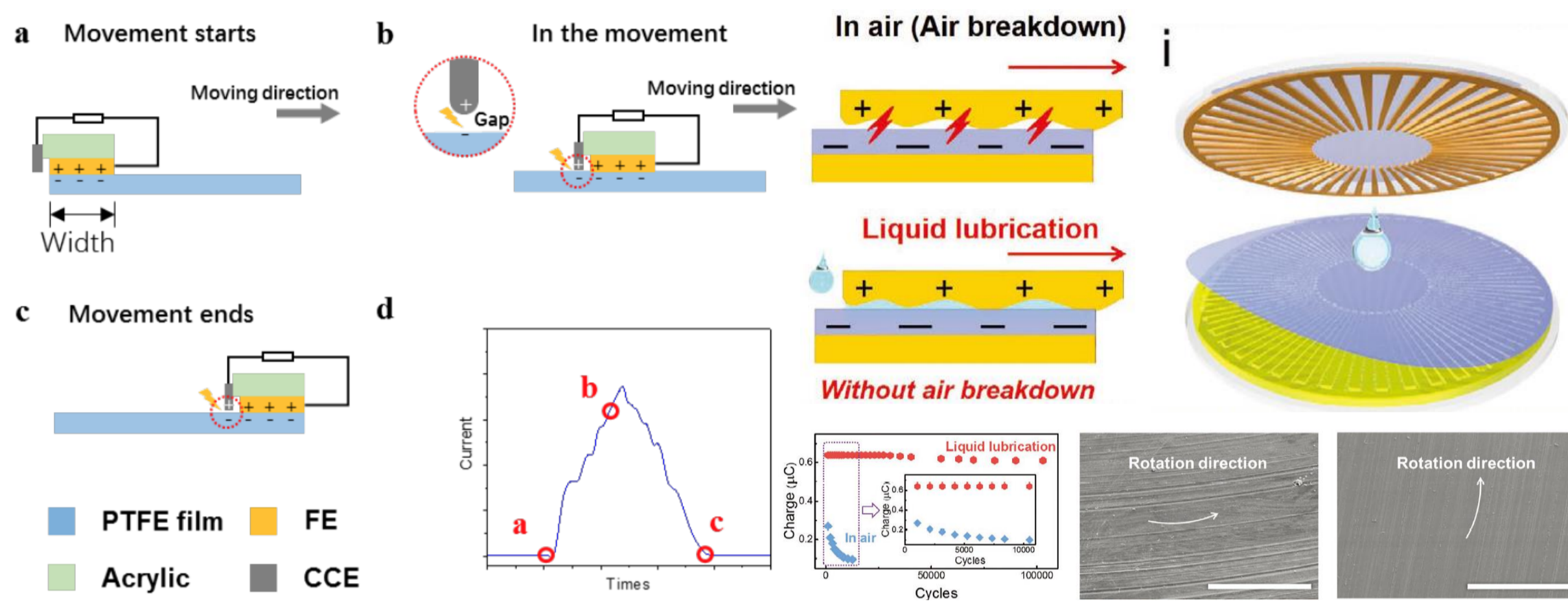
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Introduction

- Triboelectric nanogenerator (TENG) is very efficient at harvesting energy from wasted mechanical motion around us. Sliding mode TENG is considered the most efficient TENG
- However, the sliding mode TENGs have serious drawbacks of alternating-current (AC) generation and wear-off problems. These problems cause significant energy losses.
- Here, we report a polarity-controlled and soft-triggered (P-S) rotational TENG for highly durable DC power generation

Motivation

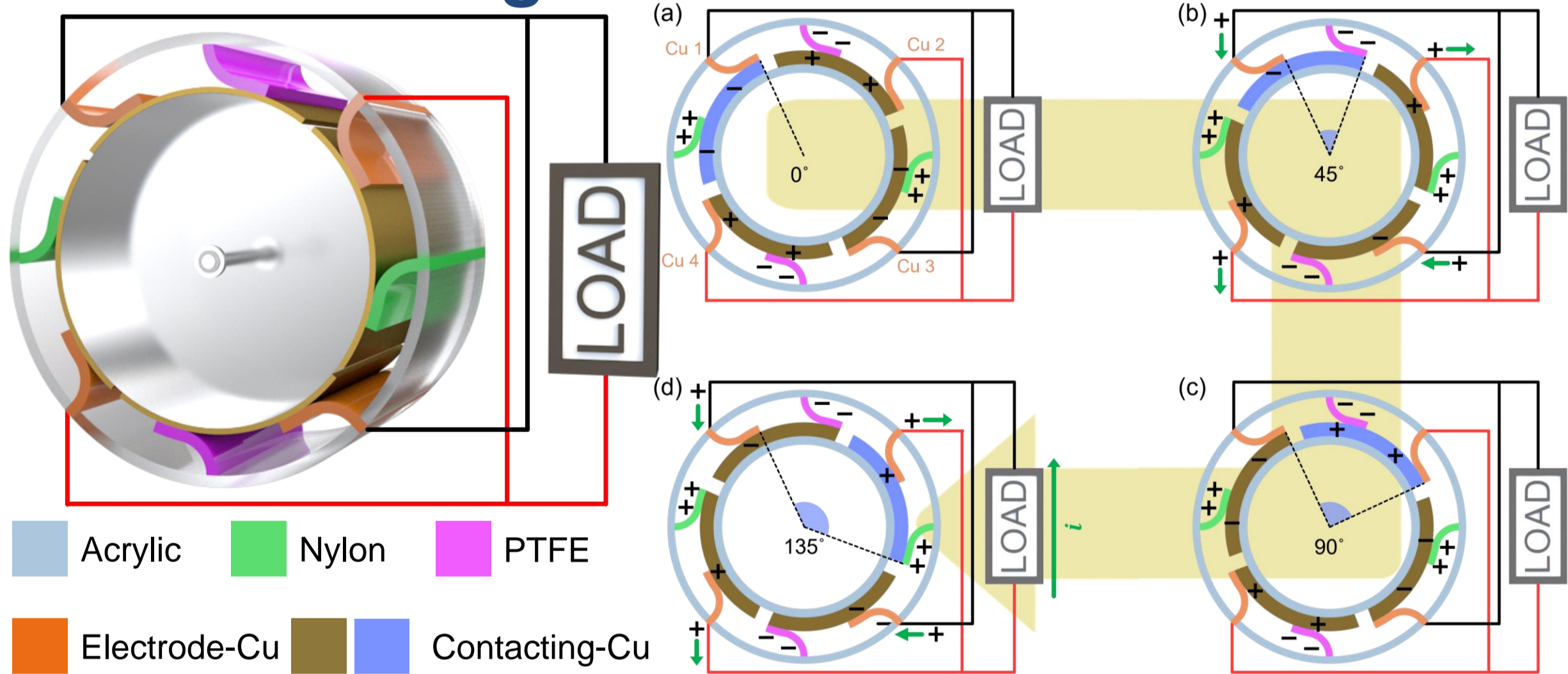


Z. Zhao. at al, *Nat. commun.*(2020)

L. Zhou. at al, *Adv. Energy Mat.*(2020)

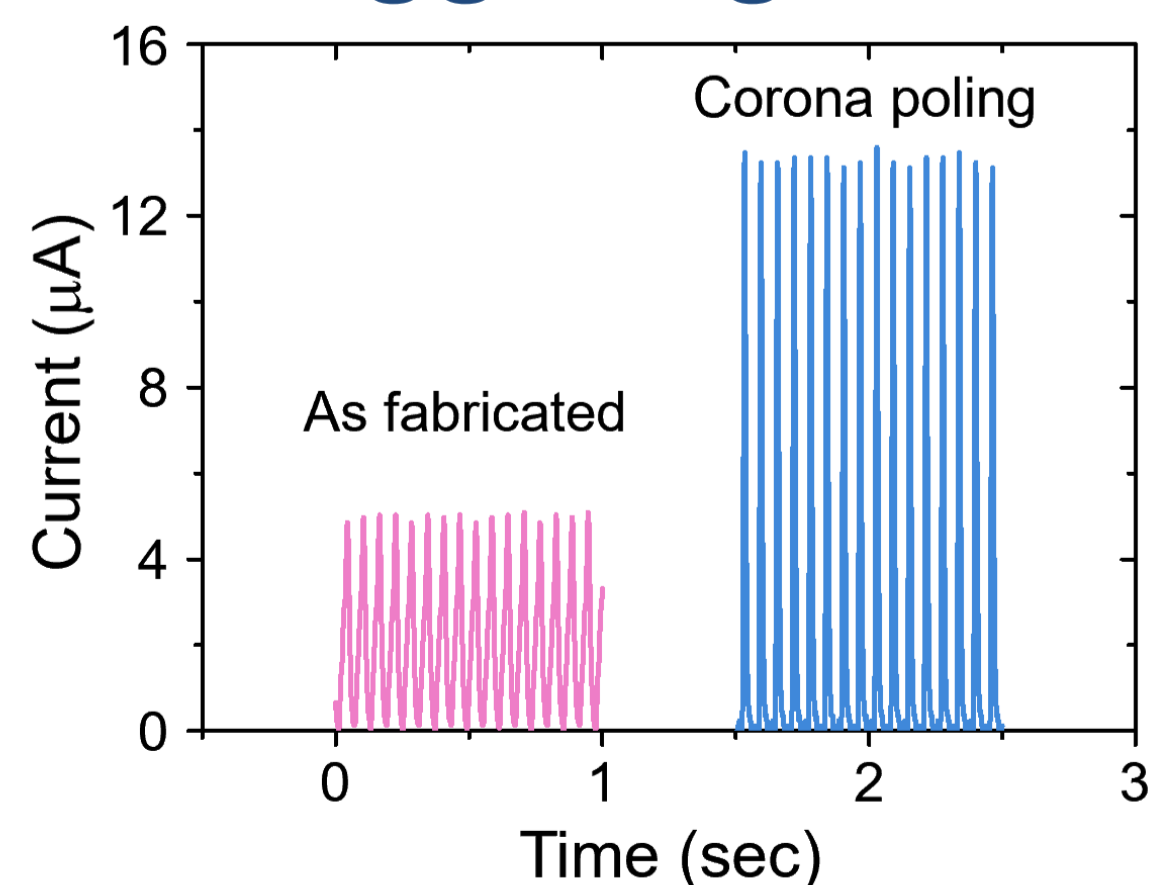
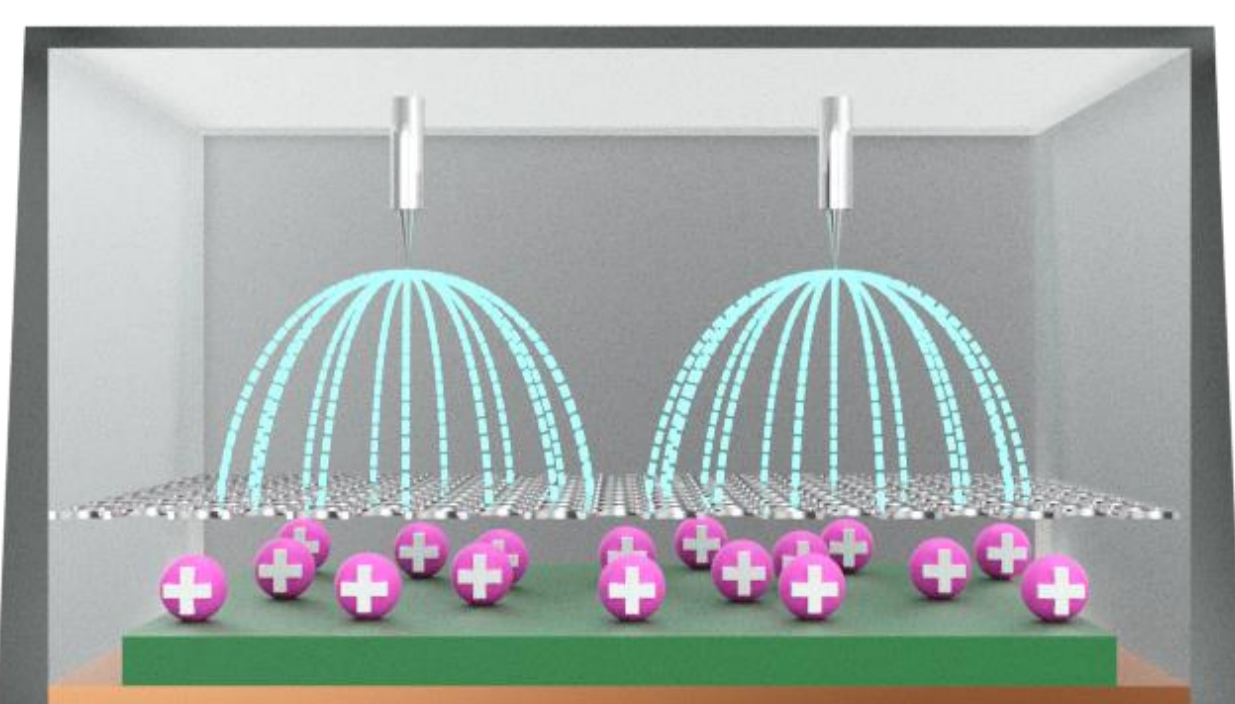
- Z. Zhao. at al demonstrated that air breakdown can be used to make direct-current (DC) TENG for elimination of rectification.
- L. Zhou. at al demonstrated that using liquid lubrication at interface between contact surfaces induce higher output and durability

Device design and Mechanism



- Copper electrodes consist of fixed Electrode-Cu and rotating Contacting-Cu, Which enable DC generation
- Left figure is P-S TENG's schematic structure and it will operate as shown on the right figure with DC generation

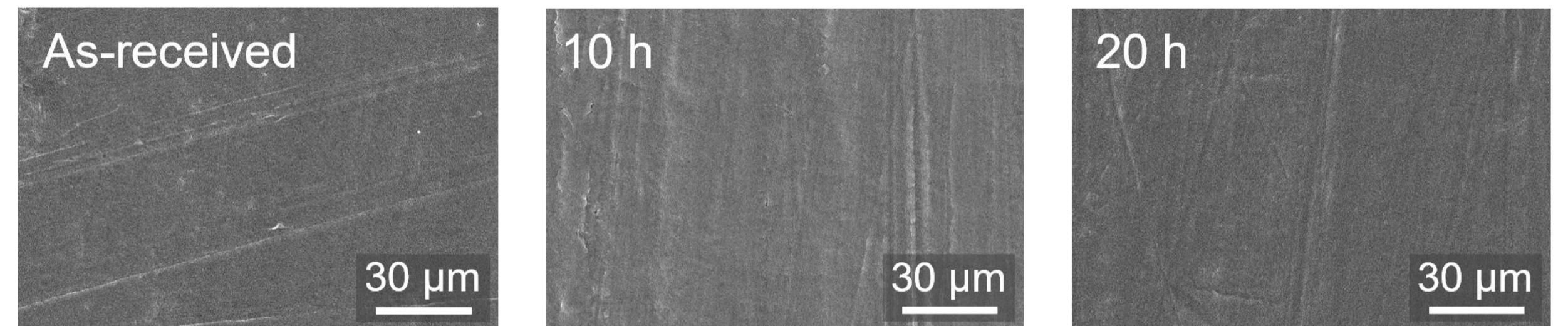
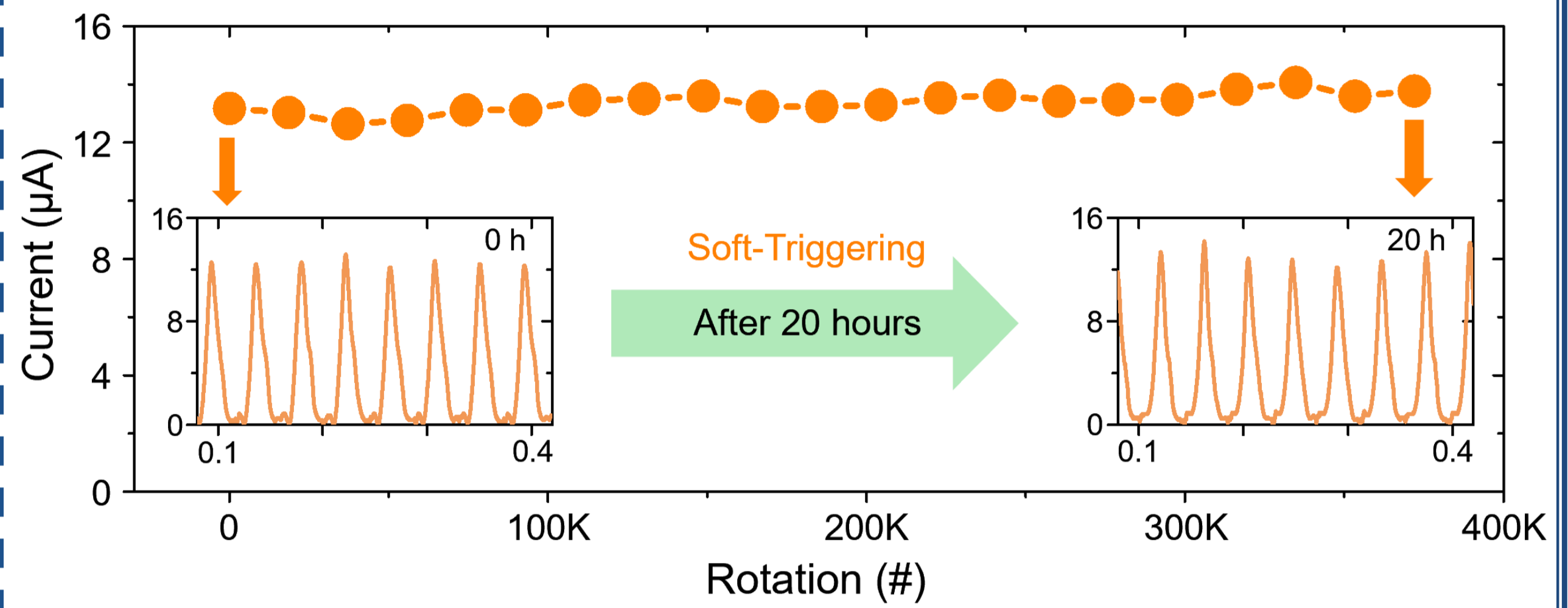
Corona discharge & Soft triggering



Summary

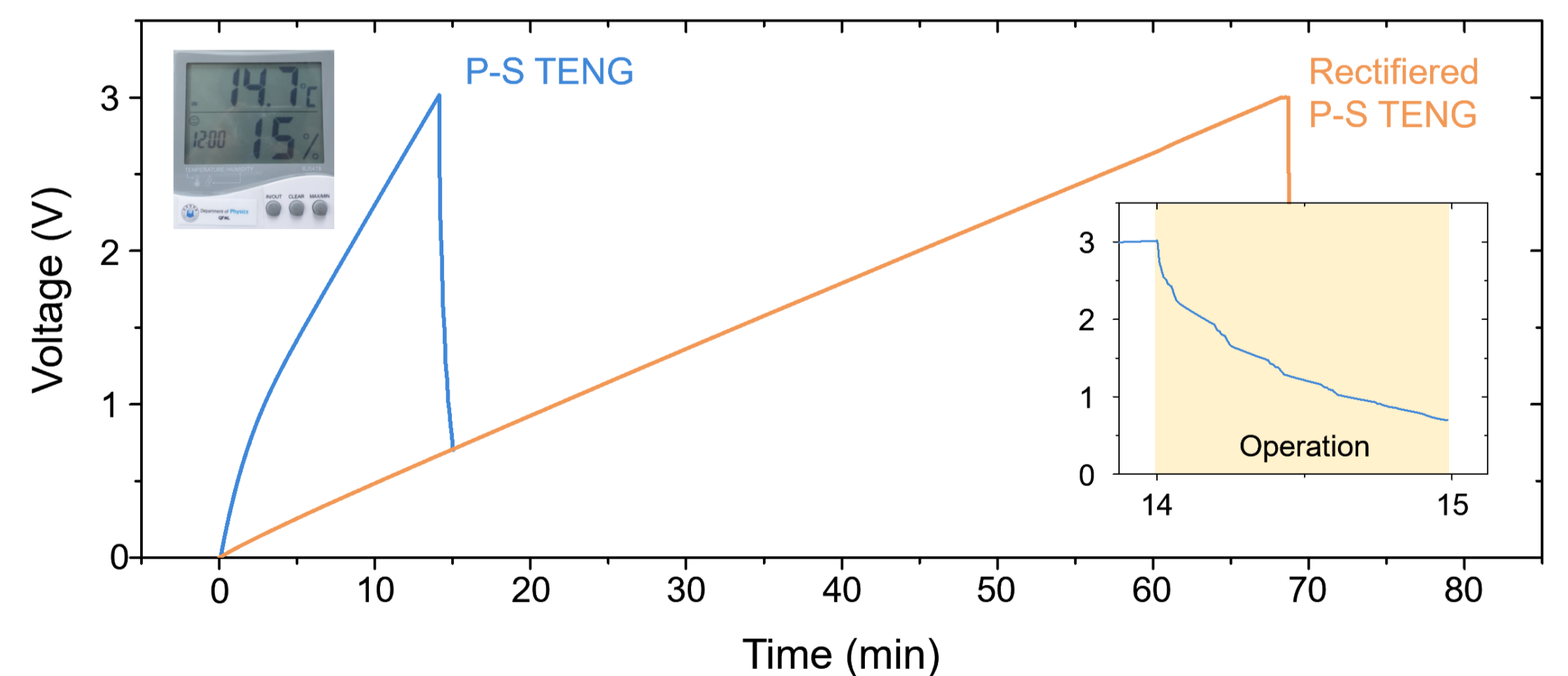
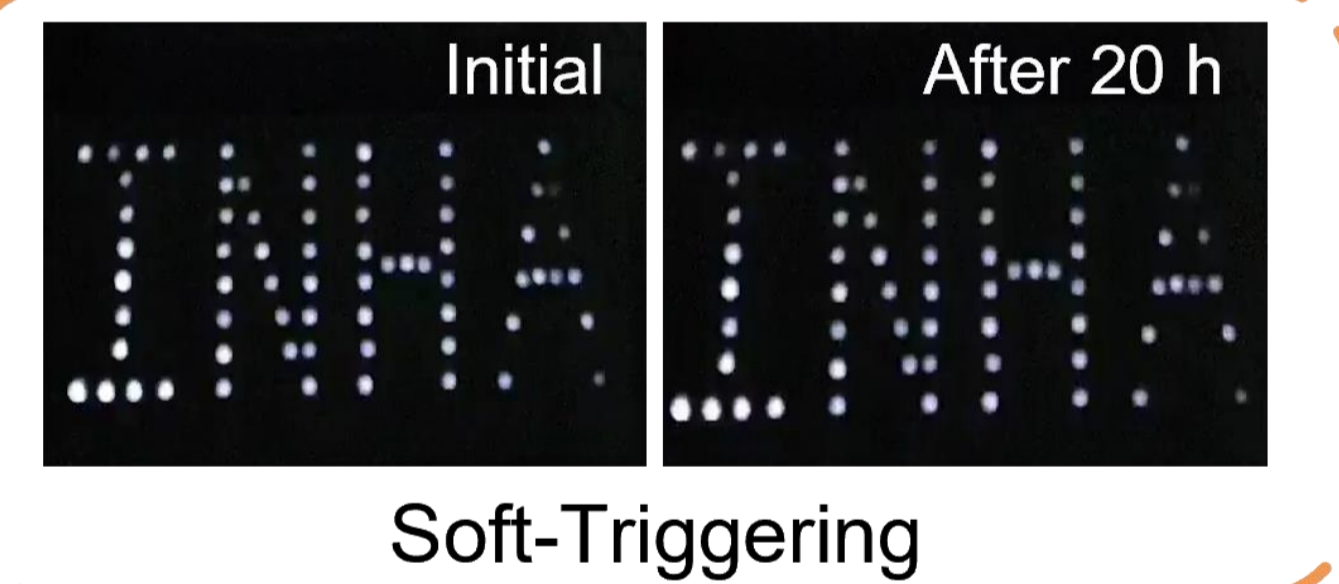
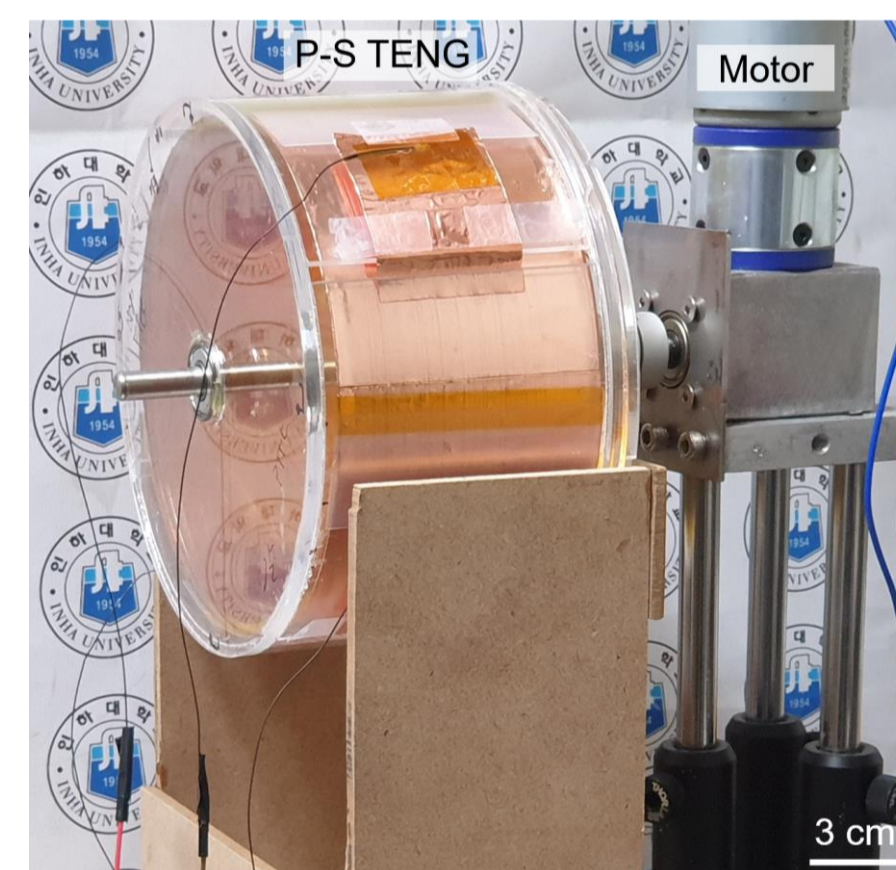
- We have developed a highly durable P-S TENG with sliding mode for DC power generation.
- The P-S TENG generated 620 V of open-circuit voltage, 14 µA of short-circuit current
- The triboelectric outputs of P-S TENG with soft-triggering remained almost constant even after 372,000 continuous rotations.

- PTFE and Nylon film was treated with corona discharge, it enhance the power of the P-S TENG's DC generation
- Right figure demonstrate the difference in current of P-S TENG before and after corona discharging



- Because of soft triggering, the DC output of P-S TENG remained nearly constant, despite 372,000 rotations.
- The SEM image demonstrate clean contact surface of Nylon film, even after 372,000 rotations.

Application



- The experiment set up is shown as first picture.
- After 20 hours of operation, the brightness of the LEDs remained effectively constant under soft-triggering
- The last figure shows the charging and discharging curves of the 470 µF capacitor.