## **Supporting Information**

## Increasing the output charge quantity of triboelectric nanogenerator through frequency-multiplying with multi-gap structure friction layer

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1. Short-circuit current and open-circuit voltage of the two-gap FTNG.

Figure S1. The short-circuit current in 5 cycles (a) and the enlarged current curve in 1 cycle (c). The open-circuit voltages in 5 cycles (b) and the enlarged voltage curve in 1 cycle (d).



2. The derivation process of the induced charge on the Al electrode.

As shown in Figure S2, the two-gap FTNG can be considered as three capacitances, CI, C2 and C3. The distances of the electrodes are d, d and d', the charge quantities are Q', Q-Q' and Q'. So, we can calculate the total energy of these three capacitances:  $W = \frac{1}{2}C1Q'^2 + \frac{1}{2}C2(Q-Q')^2 + \frac{1}{2}C3Q'^2 \dots (1)$   $C1 = \frac{\varepsilon S}{4\pi kh} \dots (2)$   $C2 = \frac{\varepsilon S}{4\pi kh} \dots (3)$  $C3 = \frac{\varepsilon S}{4\pi kd} \dots (4)$ 

Bring formula (2-4) into formula (1) and take the derivative of energy W to charge Q'. Base on minimal energy principle, the induced charge on the Al electrode can be calculated:

$$Q' = \frac{2Qh}{4h+2d}$$



Figure S3. When the positive and negative charges are accumulated on Nylon and PVDF films, these two films will attract each other under the electric field force, and the effective interstitial area will be reduced.