Enhancing the Charge Density of Triboelectric Nanogenerator via Charge Traps from Photon-Generated Carriers

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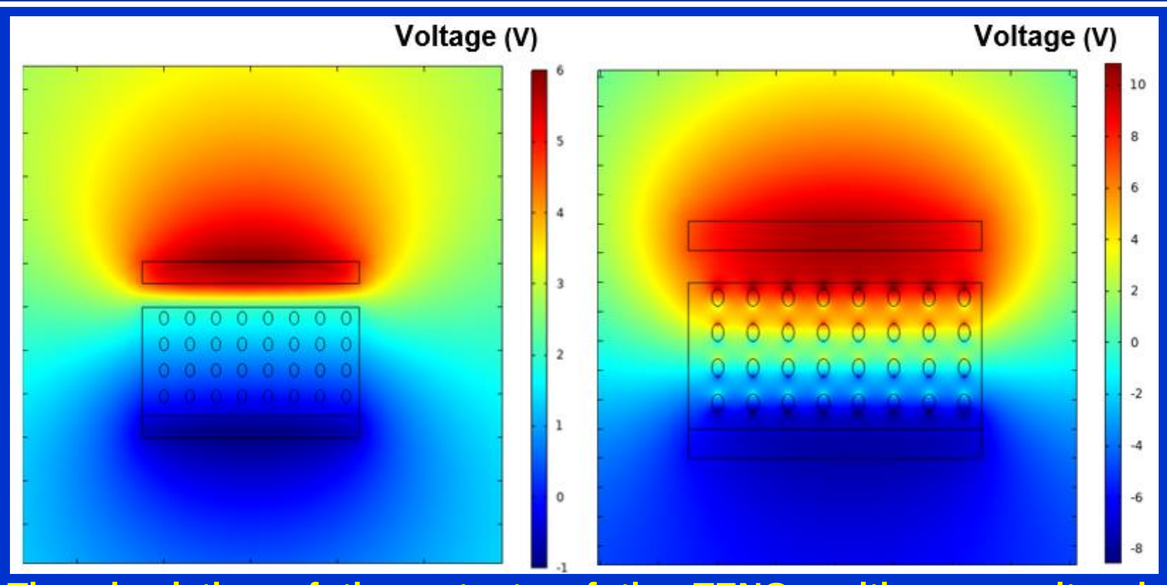
Background / Motivation

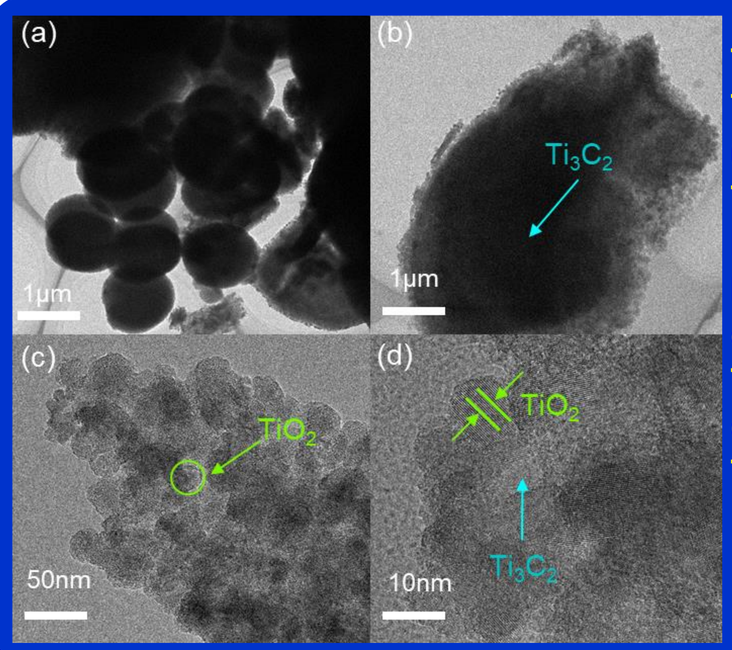
- The output performance of triboelectric nanogenerator (TENG) is an important candidate to be considered for energy supply to the sensor nodes. The previous works have focused on high dielectric particle doping, and the output performance of TENG is limited.
- A new strategy is creatively proposed based on charge traps from photon-generated carriers, which are acquired from the composites TiO_2/MXene, to further promote the output performance of TENG. biomolecules with high sensitivity and specificity.

The simulation of the outputs of the TENGs



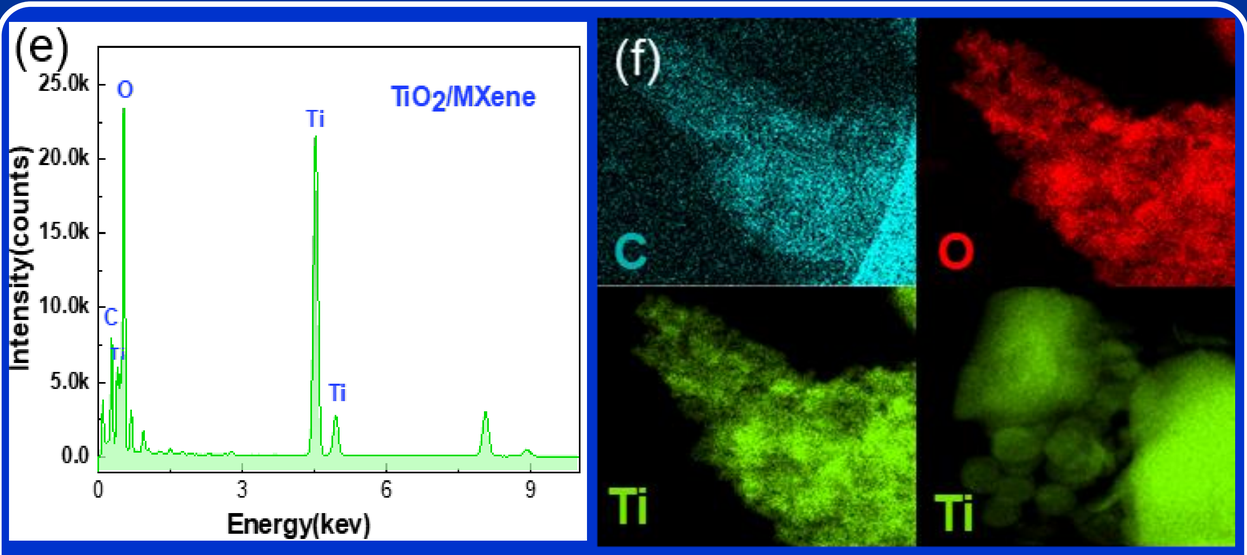
The simulation of the outputs of the TENGs with composites is contrasted before and after lighting.

The characterization of the TiO_2/MXene composites



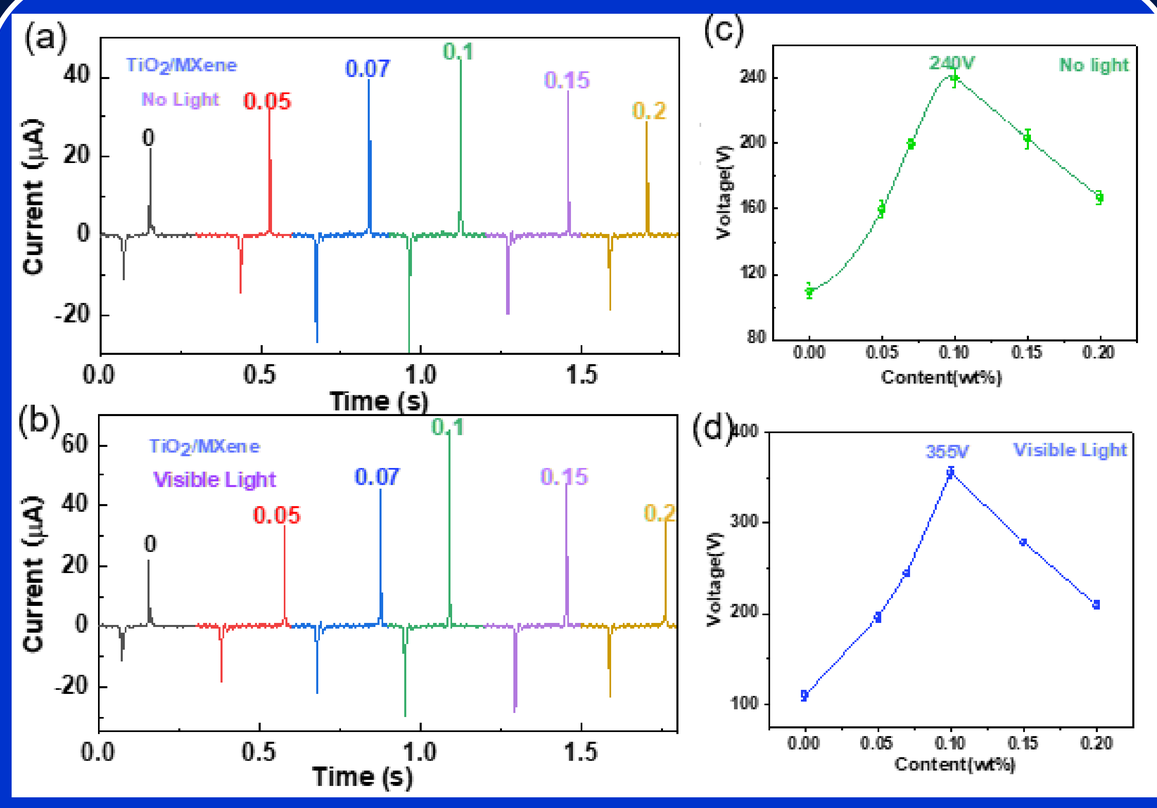
The characterization of the TiO_2/MXene composites
(a) The TEM images of the TiO2composite;
b) The TEM images of the MXenec composite ;
c) The TEM images of the TiO2/Mxenec composite ;
d) The TEM images of the TiO2/MXenec composite.

The characterization of the TiO2/MXene composites



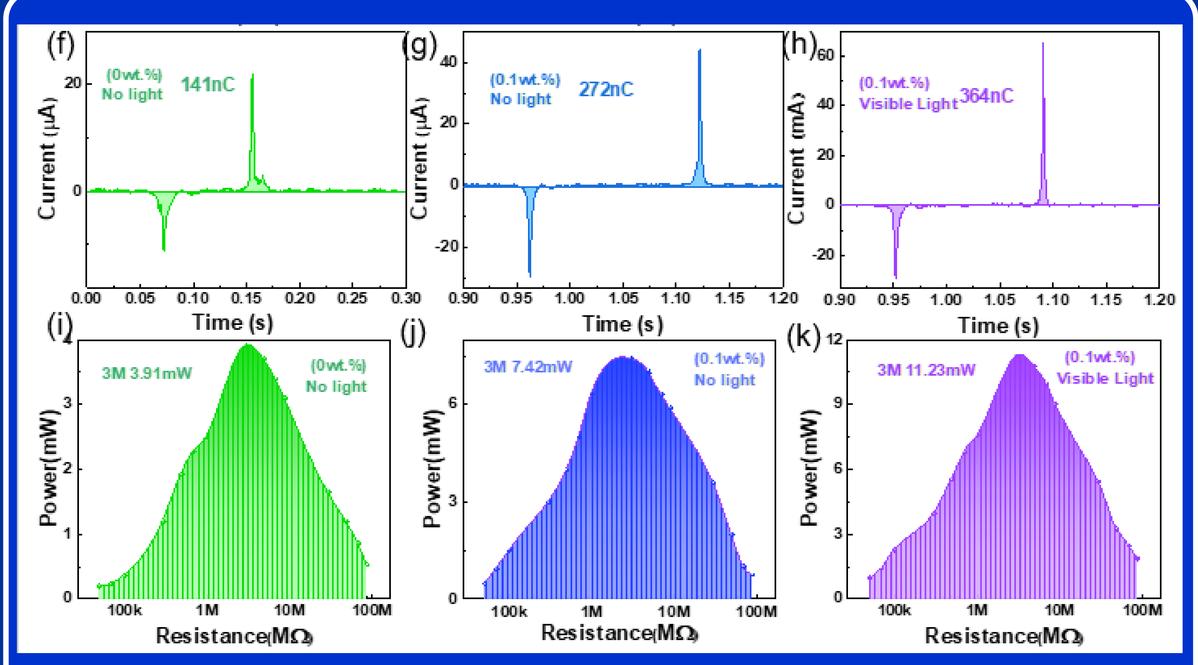
e) The result of the EDS of the TiO_2/MXene composite; (f)The TEM element characterization of the TiO_2/MXene composite.

Results and Discussion



(a)The short-circuit current of the TENG with TiO_2/Mxene composites; (b)The short-circuit current of the TENGs with TiO2/Mxene composites under the 0.6 times visible light irradiation; (c)The open-circuit voltage of the TENG with TiO2/Mxene composites; (d) The open-circuit voltage of the TENG with TiO2/Mxene composites under the 0.6 times visible light irradiation.

Results and Discussion



(f-h)The effect of light on the transferred charge quantities; (i-k)The output power of the TENG with TiO_2/MXene composites .

Summary

- The high dielectricproperties of the composites first result in the improvement of the output performance of TENG, andthen photon-generated carriers effect enables composites which are doped into tribo-material, furtherenhance the output performance.
- As the photon-generated electron–hole pairs produced by TiO_2 have ahigh recombination rate and small specific surface area, the MXene are chosen to combine with theTiO_2 and form a heterojunction at the point of interface contact which lead to more charge traps.
- A sustainable and enhanced output performance of about 63 μA (short-circuit current) and 355 V (opencircuit voltage) are produced via photon-generated carriers for the boosted TENG with the dopingcontent of 0.1wt%, and it delivers a peak output power of 11.23mW with an impedance of 1 MΩ, which isgiving over 2.9-fold enhancement in output power compared with the traditional TENG withPDMS(3.91mW).
- This work provides a profound understanding of the working mechanism of photongenerated carriers effects for boosting the output performance of TENG, and it's indeed an effective wayfor promoting TENG's output.

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