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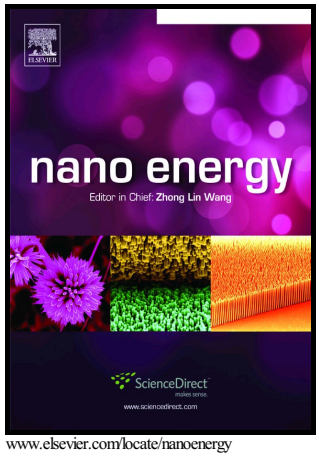


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# Integrable card-type triboelectric nanogenerators assembled by using less problematic, readily available materials

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**ABSTRACT**:

The development of portable power banks by using triboelectric nanogenerator-based technology has been a subject of great interest. However, when the potential wide range of future applications of such devices is considered, their heavy use of nanomaterials, polymers, and micro/nano fabrication technologies will increase the cost of and the energy consumed during production; moreover, their improper disposal may harm the environment. Here, we demonstrate portable card-type triboelectric nanogenerators (Card-TENGs) assembled by using less problematic, readily available materials through a top-down approach. The Card-TENG is fabricated mainly from paper, including card paper and printer paper, which can greatly reduce the fabrication cost and the risk to the environment. Electricity can be generated simply by shaking the Card-TENG, and Card-TENGs can be combined to form single and multilayer structures, which will enhance their electrical output. Furthermore, the as-fabricated Card-

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