Harvesting ambient mechanical energy is a promising approach to sustainable and maintenance-free power source for electronics that are wireless, stand-alone, and autonomous. [1–8] The sources of mechanical energy cover a wide spectrum of amplitude and frequency. Typical mechanical motions that are usually utilized include vibrations, body movement, and motions in nature such as wind and water waves. Conventional methods of converting mechanical energy mainly rely on piezoelectric effect, electromagnetic effect, and electrostatic induction. [9–17] Recently developed triboelectric generators (TEGs) have shown prominent advantages in power density due to the use of thinfi lm polymeric materials. [18–20] However, they require either two separate electrodes or a grounded electrode so that net induced charge can be created by charge redistribution. [21,22] Furthermore, they lack a general structure that works for multiple types of mechanical motions. [22–24] More importantly, all the aforementioned energy-harvesting techniques, including the TEG, generate ac output; [25–27] thus phase mismatch among separate devices brings a major problem for constructive and area-scalable integration of a number of devices.

Moreover, the units can be integrated into a 2D array over a large area to become a "power carpet." As shown by the picture in Figure 7 a, a 36-unit array is integrated on a fl exible textile substrate. Each unit has a side length of 5 cm. The connection method is schemed in Figure 7 b. Alternating cathodes and anodes are placed in lines, which are labeled in Figure 7 a. Conductive fabric-based textile was used as the material for the working electrode to make the entire device fl exible, bendable, and rollable, as shown in Figure 7 c. The PTFE fabric was adopted as the electrifi cation material, making the device entirely fabric-based.An as-fabricated device is exhibited in Figure 7 d. If spread on the fl oor, it can scavenge energy from interactions with shoes. As clearly demonstrated in Figure 7 e, output current can be produced by diverse types of motions including walking, running, jumping, and sliding friction. As explained above, the current amplitude is related to how fast the interaction is.Thus, jumping corresponds to the highest and sharpest current peaks among all types of motions, as shown in the magnifi ed insets of Figure 7 e. The produced electricity can directly power a number of small electronics (Figure 7 f; Movie S2, Supporting Information). If this area-scalable "power carpet" (Figure 7 g) can be used in places that have large fl ows of people such as subway stations and shopping malls, the produced electric energy in total may become considerable.

In summary, we report a new class of integrated dc-TEG based on the novel coupling of three-effects among triboelectrifi cation, electrostatic induction, and semiconducting properties. The asymmetric rectifying property of the p–n junctions makes them act as unidirectional "gates" that regulate the induced charge to transport in a single direction. Metal–semiconductor Schottky contacts that are also rectifying may replace the p–n junction, which can further simplify the structure. Compared to previously reported TEGs, the integrated dc-TEG has a planar structure with only one layer of electrode that has an extremely small thickness. Besides, electricity can be generated regardless of how a charged external object interacts with the integrated dc-TEG. Most importantly, output current from different units can always constructively add up, thus presenting a feasible route to large-area applications of the TEG and other energy-harvesting techniques.