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Identification of Biomolecules by Triboelectric Nanogenerators

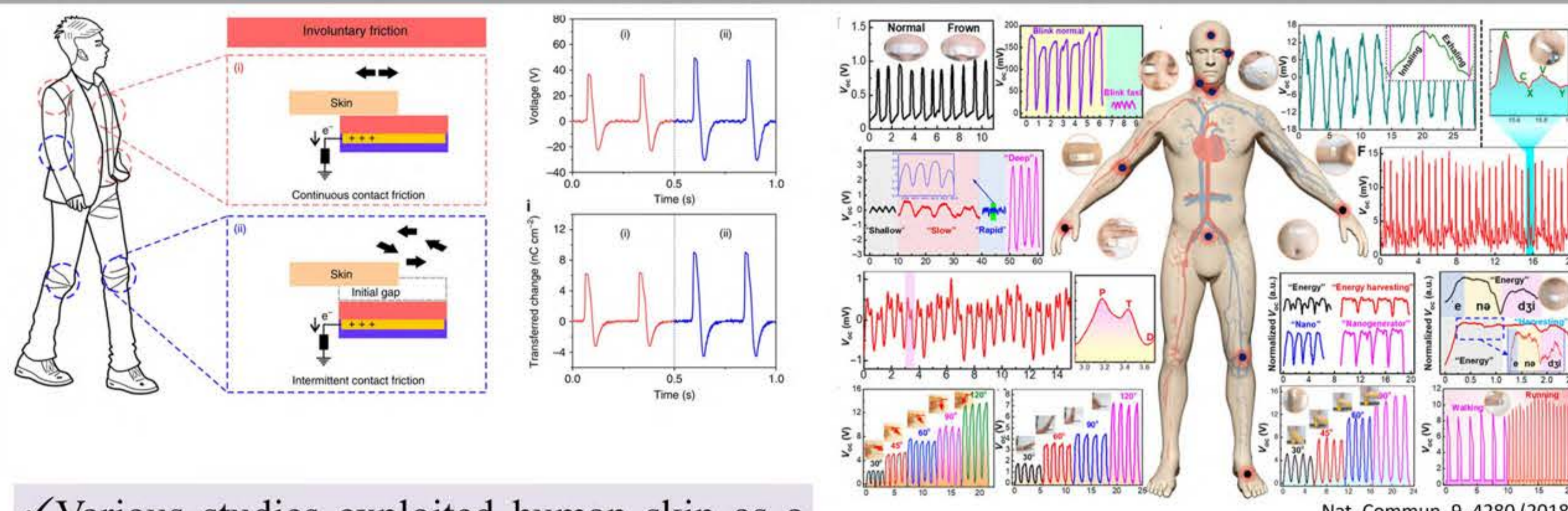
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Triboelectrification necessitates a frictional interaction between two dissimilar materials, and their contact electrification is characteristically based on the polarity variance in the triboelectric series. Utilizing this fundamental advantage of the triboelectric phenomenon, different materials can be identified according to their contact electrification capability. Herein, we perform an in-depth analysis of the amino acids present in the stratum corneum of human skin, and we quantify them regarding triboelectric polarization. The principal focus of this study lies in analyzing and identifying the amino acids present in copious amounts in the stratum corneum to explain their positive behavior during the contact electrification process. Thus, we present an augmented triboelectric series of amino acids with quantified triboelectric charging polarity by scrutinizing the transfer charge, work function, and atomic percentage. Furthermore, we detect the chirality of aspartic acid as it is most susceptible to racemization with clear consequences on the human skin. We expect this study to accelerate research exploiting triboelectrification and provide valuable information on the surface properties and biological activities of these important biomolecules.

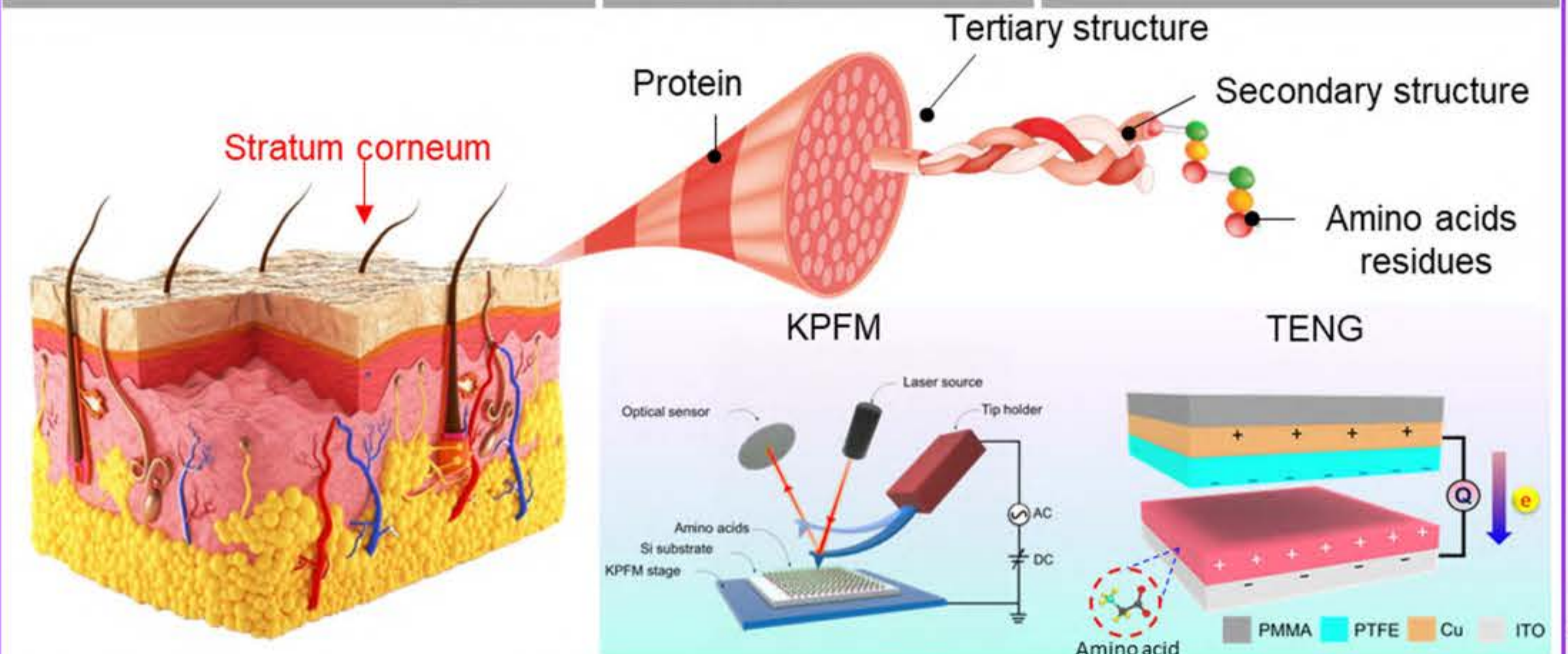
Motivation



- ✓ Various studies exploited human skin as a positive triboelectric material for energy harvesting, sensing, and various other applications.
- ✓ It has a wide range of uses for self-powered sensing and energy harvesting purposes.

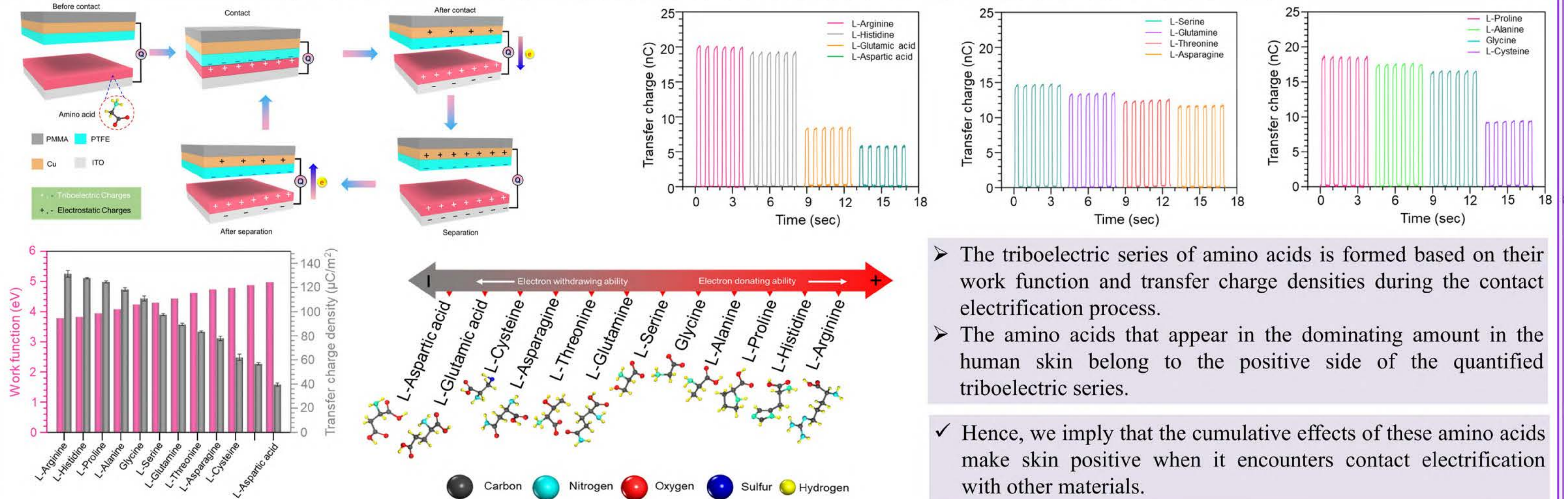
But why does human skin become positively charged during the contact electrification process?

Proposed concept



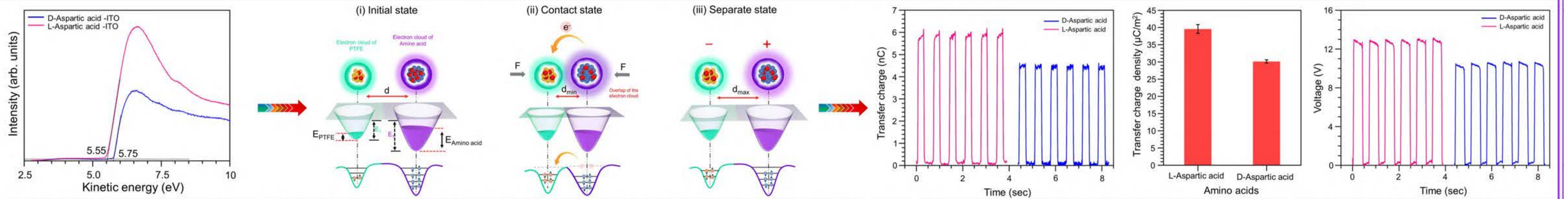
The basic constituents of the human skin are amino acids and some particular of these appear in the **dominating amount** in the human skin. Herein, Kelvin probe force microscopy and triboelectric nanogenerator were utilized to quantify the amino acids in an augmented triboelectric series.

Quantification process and construction of triboelectric series

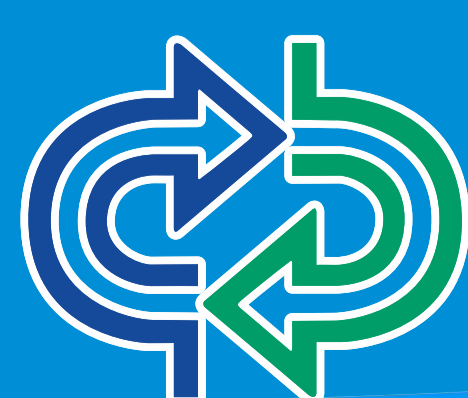


- The triboelectric series of amino acids is formed based on their work function and transfer charge densities during the contact electrification process.
- The amino acids that appear in the dominating amount in the human skin belong to the positive side of the quantified triboelectric series.
- ✓ Hence, we imply that the cumulative effects of these amino acids make skin positive when it encounters contact electrification with other materials.

Detection of homochiral molecules



- ✓ By utilizing the contact electrification phenomenon, we have successfully demonstrated the detection of homochiral amino acids. The detection of the homochiral amino acids shows the advantage of our technique to solve various scientific problems and pave new paths for hi-tech self-powered biomolecular detection technologies.



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