Biomimetic fibrous Murray membranes with ultrafast water transport and evaporation for smart moisture-wicking fabrics

With the support by the National Natural Science Foundation of China, a study by the research group led by Prof. Ding Bin (丁彬) and Prof. Wang XianFeng (王先锋), both from the Innovation Center for Textile Science and Technology, Donghua University, demonstrates the antigravity directional water transport and quick dry performance in the biomimetic micro- and nanofibrous Murray membranes, which was published in *ACS Nano* (DOI: 10.1021/acsnano.8b08242).

Functional textiles with moisture wicking technology have attracted increasing attention due to their capability of providing quick drying effect in a hot and humid environment, resulting in a comfortable microclimate to the wearer. Nowadays, most moisture-wicking fabrics are composed of synthetics such as polyester and nylon, which can pull the sweat away from the skin and absorb very little moisture. Notably, the Coolmax fabric made with profiled fibers has been recognized as an effective strategy to realize the quick drying performance because of its moderately hydrophobic and special groove structure. However, the moisture-wicking process in such fabrics is bidirectional, which means that significant amount of moisture would remain in the inner layer of fabrics.

To address these limitations, the authors designed a smart moisture-wicking fabric with antigravity directional water transport and quick-dry performance based on the combination of biomimetic Murray network and surface energy gradient. The underlying principles of the optimal hierarchical structure follow from the application of Murray's law, which was found in the transpiration in vascular plants possess, resulting in the ultrafast water transport and evaporation of the fabrics. Moreover, the asymmetric wettability and anisotropic breakthrough pressure were constructed by introducing the surface energy gradient, thus making the inner layer extremely dry. The resulting moisture-wicking fabrics based on the porous Murray membranes exhibit an ultrahigh one-way transport capability of 1245% and an outstanding water evaporation rate of 0.67 g h^{-1} (5.8 and 2 times higher than the cotton fabric and Coolmax fabric, respectively).

This work may provide new insight into the development of moisture-wicking technologies, thus providing and extremely dry and personal comfort during the sweat-producing exercise.

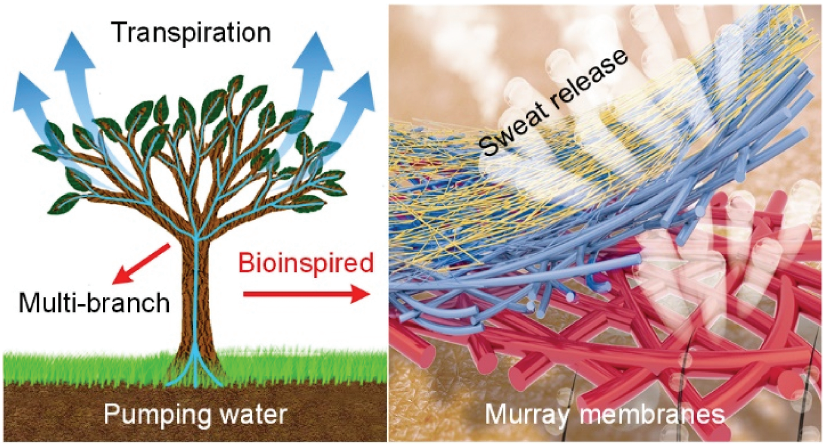

Figure The transpiration of the vascular plants and the sweat-release process of biomimetic micro- and nanofibrous Murray membranes.