

Simulation of droplet movement on a spider silk with contact angle hysteresis

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Spider silk has a directional water collecting ability. It results from the special structure of the silk, which has two distinct regions of hydrophilic flat cylindrical region and more hydrophilic convex cylindrical region. Condensation occurs on many sites and makes many small droplets. Droplets are getting bigger and are gathered to convex regions. This phenomenon consists of two steps: volume increase of droplets and droplet movement to convex region. Droplet volume increase induces contact angle hysteresis and droplet transfer is affected by the differences in hydrophilicity and geometry. But the dominant factor for droplet transfer between two causes is not known up to now. Thus, we performed simulations with one factor only, i.e. the hydrophilicity difference only or the geometry difference only, while the contact angle hysteresis effect is included. We used the level set method (LSM) in COMSOL Multiphysics. This study is expected to be helpful for various applications such as the design of fibrous filter systems.