Efficient Fog Harvesting Interface With Bio-Inspired Multilayer Micro Kirigami

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Effectively utilizing atmospheric water is a sustainable solution to short-term water shortages. Fog water meets international safety standards and reduces the technical complexity and cost of conventional water supply systems. It is highly applicable in many regions with water inaccessibility such as Chile and Namibia, since fog is abundant in coastal dry lands. Nonetheless, the application of fog collectors is highly limited as current models cannot achieve high efficiency, simple structure, and low price simultaneously. Inspired by cacti, butterfly proboscides, and Namib beetles, this research presents a fog-harvesting kirigami with a hydrophobic-superhydrophilic Janus interface to address these challenges. The thin, horizontal spine structure facilitated more effective fog collision by reducing the boundary layer thickness and colliding fog in multiple directions. When testing the optimal structure, double-layer samples with hydrophilic capillary channels showed the highest efficiency under close-to-realistic fog concentration. The parameters with the best efficiency are stem width 0.5mm, spine length 1mm, spine width 0.4mm, and spine gap 0.5mm. It can readily pull intercepted droplets into the interface, which effectively prevents evaporation. It achieves a rate of ~5752 mg•cm-2•h-1, which exceeds that of the unmodified single-layer model in this research by 28.5%. Simplified to a 2D structure, it is also highly feasible as its fabrication merely requires a laser cutter, and the material only costs $0.81 m-1. This design could alleviate the global freshwater crisis by encouraging more communities to adopt fog harvesting since it reduces the maintenance difficulties, relieves financial burden, can support more industries with water demand to boost local development.

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