

Environmental Research, Technology Demonstration and Conference Project

ECF Project:	ECF 2021-91
Project Title:	Optimal design of high performance textile-based solar steam generator by tunable capillary evaporation
Principal Investigator:	Dr Shou Dahua, Institute of Textiles and Clothing, The Hong Kong Polytechnic University
Total Approved Grant:	\$485,300
Duration:	1/9/2022 to 31/8/2024
Project Status/Remarks:	On-going
Project Scope:	<p>Solar steam generation is emerging as a promising strategy to provide clean water while fully utilizing the abundant solar energy. Traditional solar steam generation is based on heating the entire amount of the water source with a low energy conversion efficiency at 40%. The recent advancement of advanced materials such as hydrogel, titanium trioxide, and gold nanoparticles enables higher solar-to-thermal conversion by heat localization. The latest device designs from 1D to 3D and from single-stage to multi-stage have also improved liquid delivery and thermal distribution. However, the existing systems are often engineered at the expense of high cost, complex fabrication, and low durability. Here, the project team proposes a facile and innovative strategy by tailoring the capillary evaporation using commercially available fabrics, to maximum liquid-vapor conversion efficiency by optimal interplay of capillary-driven liquid transport and evaporation-based steam generation. The proposed system with Janus wettability will accelerate the steam generation by the enhanced thin-film evaporation and the optimally determined wicking structure. This versatile technology will increase the evaporation rate by 30% from an existing system and have an ultrahigh energy conversion efficiency at 95%, significantly reducing the greenhouse gas emissions from consumption of fossil fuels in Hong Kong.</p>
Summary of the Findings/Outcomes:	To be available upon completion of the project