System design of solar-to-steam generation with efficiency > 90% at one sun

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Recently, the black plasmonic-metal absorbers have attracted much attention as an effective material for generating solar-steam. However, conventional black plasmon absorbers are generally small, rely on high optical density systems, and also have relatively low efficiency due to high heat loss through convection, conduction, and radiation. To solve this problem, we have developed a strategy for producing highly effective black plasmon absorber based on cellulose filter paper with hydrophilic, porous, high water absorption capacity and high water diffusion capacity. In this strategy, a black plasmon absorber was fabricated by immobilizing gold nanoparticles on a cellulose filter paper using a dry plasma reduction method. The fabricated black plasmon absorber adhered onto the foam with excellent thermal insulation, which not only naturally floated on the surface of the water but also reduced heat loss due to conduction and radiation. Applying it to solar-steam generation, we achieved solar conversion efficiencies of about 90% at 1 sun intensity.