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Off-grid production of cellulosic bioethanol using solar steam generated with nanoparticles

Conventional bioethanol for transportation fuel typically consumes agricultural feedstocks also suitable for human consumption and requires large amounts of energy for conversion of feedstock to fuel. Alternative feedstocks, optimally those not also in demand for human consumption and off-grid energy sources for processing, would both contribute to making bioethanol far more sustainable than current practices. Cellulosic bioethanol production involves three steps: The extraction of sugars from cellulosic feedstock, the fermentation of sugars to produce ethanol and the purification of ethanol through distillation. Traditional production methods for extraction and distillation are energy intensive and therefore costly, limiting the advancement of this approach. Here we report an initial demonstration of the conversion of cellulosic feedstock into ethanol by completely off-grid solar processing steps. Our approach is based on nanoparticle-enabled solar steam generation, where high-efficiency steam can be produced by illuminating light-absorbing nanoparticles dispersed in H_2O with sunlight. We used solar-generated steam to successfully hydrolyze feedstock into sugars, then used solar steam distillation to purify ethanol in the final processing step. Coastal hay, a grass grown for livestock feed across the southern US and sugar cane as a control, are successfully converted to ethanol in this proof-of-concept study. This entirely off-grid solar production method has the potential to realize the long-dreamed-of goal of sustainable cellulosic bioethanol production.

Biography

Oara Neumann has completed her MS from Weizmann Institute of Science, Israel, her PhD and postdoctoral studies from Rice University. She is a Research Scientist in Naomi Halas group at Rice University. She has published more than 25 papers in reputed journals.

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