

Title: Nanoparticles Assisted Green Production of Bioethanol

Oara Neumann, Ph.D., Applied Physics, Rice University, TX, 77005, USA

Abstract: 300 words

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 H2O with sunlight. We used solar-generated steam to hydrolyze feedstock into sugars successfully, then used solar steam distillation to purify ethanol in the final processing step. Coastal hay, a grass grown for livestock feed across the southern U. S., 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.

Recent Publications: (Minimum 5)

1. P. D. Dongare, A. Alabastri, O. Neumann, P. Nordlander, and N. J. Halas, “Solar Thermal Desalination as a Nonlinear Optical process.” PNAS (2019) (ASAP).
2. L. Henderson, O. Neumann, C. C. Kaffes, R. Zhang, V. S. Marangoni, M. K. Ravoori, V. Kundra, J. A. Bankson, P. Nordlander, and N. J. Halas, “Routes to Potentially Safer T1 MRI Contrast in a Compact Plasmonic Nanoparticle with Enhanced Fluorescence.” ACS Nano, 12(8), 8214-8223, (2018).
3. M. Goodman, O. Neumann, K. Nørregaard, L. Henderson, S. W. Bishnoi, M. R. Choi, S. E. Clare, and N. J. Halas, “Near-Infrared Remotely-Triggered Drug Release Strategies for Cancer.” PNAS, 114(47), 12419-12424, (2017).
4. S. Tian, O. Neumann, M. J. McClain, X. Yang, L. Zhou, P. Nordlander, and N. J. Halas, “Label-free Surface-Enhanced Raman Spectroscopy of ssDNA on Aluminum Nanocrystal Aggregates.” Nano Lett., 17(8), 5071-5077, (2017).
5. P. D. Dongare, A. Alabastri, S. Pedersen, K. R. Zodrow, N. J. Hogan, O. Neumann, J. Wu, Q. Li, P. Nordlander, and N. J. Halas, “Nanophotonics-enabled solar membrane distillation for off-grid water purification.” PNAS, 114(27), 6936-6941, (2017).
6. V. S. Marangoni*, O. Neumann*, L. Henderson, C. C. Kaffes, H. Zhang, S. Bishnoi, C. Ayala-Orozco, V. Zucolotto, J. Bankson, P. Nordlander, and N. J. Halas, “Gd(III)-encapsulating Au Nanomatryoskhas: enhanced T1 Magnetic Resonance Contrast in a Theranostic Nanoparticle.” PNAS, 114(27), 6960-6965, (2017) (*equal contribution).
7. O. Neumann*, A. D. Neumann*, S. Tian*, C. Thibodeaux, S. Shubhankarl, J. Müller, E. Silva. S. W. Bishnoi, P. Peter Nordlander, and N. J. Halas, “Combining solar steam processing and solar distillation for off-grid cellulosic bioethanol production.” ACS Energy Lett., 2 (1), 8-13 (2017) (*equal contribution).

Biography: (150 words limit)

Oara Neumann is the Peter M. and Ruth L. Nicholas Research Scientist at Rice University (a fully funded, endowed research scientist position at the university). She has completed her Ph.D. and Postdoctoral study in Applied Physics at Rice University, an MSc in Chemical Physics from Weizmann Institute of Science, Israel, and an MSc in Analytical Chemistry from Bucharest University, Romania. Oara Neumann is the pioneer of nanoparticle-based solar thermal applications. She holds several patents, and she has published more than 27 refereed articles and has an h-index of 16.

Email: Oara.Neumann@rice.edu