U.S. Department of Energy
Categorical Exclusion Determination Form

Program or Field Office: Advanced Research Projects Agency - Energy (ARPA-E)

Project Title: 25A1028 - Towards Scale Solar Conversion of CO2 and Water Vapor to Hydrocarbon Fuels

Location: Pennsylvania

Proposed Action or Project Description:

American Recovery and Reinvestment Act: ☒

We have achieved efficient solar conversion of CO2 and water vapor to methane andother hydrocarbons using high surface area nitrogen doped titania nanotube arrays, sensitized with nano-dimensional islands of co-catalysts copper and Ni, Pd or Pt [Varghese et al., Nano Letters 9 (2009) 731]. Intermediate reaction products, H2 and CO (e.g. syngas), are also detected, with relative concentrations dependent upon the nature of the co-catalysts. Using outdoor sunlight with a power density between 75 to 102 mW/cm2, a hydrocarbon production rate (normalized to AM 1.5G, 100 mW/cm2) of 111 ppm cm-2 hr-1 (≈ 160 μL/g•hr) is obtained. This rate of CO2 to hydrocarbon production obtained under outdoor sunlight is over 20x higher than any previous published reports, which were conducted under laboratory conditions using UV illumination. Considering both hydrocarbon and hydrogen fuel products, the total production rate is about 273 ppm/cm2•hr representing a sunlight to fuel energy photoconversion efficiency of approximately 0.1%. We propose to build upon our preliminary efforts to achieve ≈ 2% sunlight to chemical fuel conversion efficiency via CO2 reduction. In Phase II we proposal system implementation of a stand-alone 9 m2 collector for high rate solar photocatalytic reduction of CO2 and water vapor producing (10 h day) fuel equivalent to approximately ≈ 165 L of natural gas (mostly methane) that can be used in a closed loop (zero GHG emission) system. Implementation of this transformational technology

Categorical Exclusion(s) Applied:

X - B3.6 Siting/construction/operation/decommissioning of facilities for bench-scale research, conventional laboratory operations, small-scale research and development and pilot projects

X - B3.8 Outdoor ecological/environmental research in small area

*-For the complete DOE National Environmental Policy Act regulations regarding categorical exclusions, see Subpart D of 10 CFR10 21 Click Here

This action would not: threaten a violation of applicable statutory, regulatory, or permit requirements for environment, safety, and health, including DOE and/or Executive Orders; require siting, construction, or major expansion of waste storage, disposal, recovery, or treatment facilities, but may include such categorically excluded facilities; disturb hazardous substances, pollutants, contaminants, or CERCLA-excluded petroleum and natural gas products that pre-exist in the environment such that there would be uncontrolled or unpermitted releases; or adversely affect environmentally sensitive resources (including but not limited to those listed in paragraph B.(4)) of Appendix B to Subpart D of 10 CFR 1021). Furthermore, there are no extraordinary circumstances related to this action that may affect the significance of the environmental effects of the action; this action is not "connected" to other actions with potentially significant impacts, is not related to other proposed actions with cumulatively significant impacts, and is not precluded by 40 CFR 1506.1 or 10 CFR 1021.211.

Based on my review of information conveyed to me and in my possession (or attached) concerning the proposed action, as NEPA Compliance Officer (as authorized under DOE Order 451.1B), I have determined that the proposed action fits within the specified class(es) of action, the other regulatory requirements set forth above are met, and the proposed action is hereby categorically excluded from further NEPA review.

NEPA Compliance Officer: /s/ William J. Bierbower Digitally signed by William J. Bierbower DN: cn=William J. Bierbower, o, ou, email=william.bierbower@hq.doe.gov, c=US Date: 2009.12.15 11:15:57 -05'00' Date Determined: 12/15/2009

Comments:

Webmaster:

of natural gas (mostly methane) that can be used in a closed-loop (zero GHG emission) system. Implementation of this transformational technology on even a modest scale will reduce green house gases, enhance energy security, and help restore scientific leadership within the U.S. We are currently at TRL 3, and seek to move to TRL 7 at project completion.