



U.S. Department of Energy

Categorical Exclusion Determination Form

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

Project Title: 25A2445 - Ammonothermal Bulk GaN Crystal Growth for Energy Efficient Lighting

Location: New York

Proposed Action or Project Description:

American Recovery and Reinvestment Act:

This ARPA-E program plans to address the vast energy loss and consumption associated with conventional lighting by developing a new route to large, high-quality, single crystals of gallium nitride. These crystals will serve as substrates for LEDs offering high-efficiency lighting. Around 8% of the energy consumption in the U.S. is from lighting, and by 2025, the U.S. could consume as much as 1,000 TWh per year. In addition, conventional light sources can account for more than 25% of a building's energy demands in the forms of direct energy for lighting, waste heat from the lights, and higher HVAC costs due to the waste heat. With its more efficient light production and minimal waste heat, gallium-nitride (GaN) Solid- State Lighting (SSL) technology has the potential to reduce energy consumption by more than an order of magnitude. GaN SSL devices currently suffer from reliability, cost, and efficiency limitations that are a result of devices being grown on heterogeneous substrates with mismatched lattice parameters, thus leading to defects in the epitaxial layers. Research has shown that these limitations can be overcome using a high-pressure ammonothermal process to produce affordable, high quality, lattice matched single crystal GaN substrates, in bulk, at high crystal growth rates (greater than 10 microns/hour). This process is inherently scalable for mass production and leads to substrates with costs matching those of current, commercially available lighting sources. Complete replacement of white lighting

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

*-For the complete DOE National Environmental Policy Act regulations regarding categorical exclusions, see Subpart D of 10 CFR 1021 [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: 2010.01.15 16:24:01 -05'00' Date Determined: 01/15/2010

Comments:

Webmaster:



25A2445 – Proposed Action or Project Description (Continued)

and leads to substrates with costs matching those of current, commercially available lighting sources. Complete replacement of white-lighting technologies (including incandescent, fluorescent, and high intensity discharge sources) with GaN SSL devices that were even 50% efficient would reduce the amount of electricity used for lighting by 70% and total energy consumption by more than 14%. By 2025 there would be a reduction in energy consumption of approximately 650 TWh per year, equating to roughly a 100-megaton drop in carbon production (through reduced CO₂ emissions) over that time. The production of bulk, single crystals of GaN demands exceptional knowledge in the area of supercritical-fluid chemistry and the ability to engineer reactors that operate at temperatures in excess of 700°C and pressures of more than 5 kbar. The team for this program—Momentive Performance Materials, Advanced Photonic Crystals, Clemson University, and Soraa, brings unmatched innovative technical expertise in these areas as well as those of the crystal growth and LED-device development needed to commercialize this exciting new technology and transform the way we use energy the world over.