



U.S. Department of Energy
Advanced Research Projects Agency – Energy
Announcement of Teaming Partner List
for an upcoming Funding Opportunity Announcement:
Power Nitride Doping Innovation Offers Devices Enabling SWITCHES
(PNDIODES)

The Advanced Research Projects Agency Energy (ARPA-E) intends to issue a Funding Opportunity Announcement (FOA) entitled: *Power Nitride Doping Innovation Offers Devices Enabling SWITCHES (PNDIODES)* to fund the development of a selective area doping process that can be used to fabricate high quality p-n junctions in the III-Nitride material system for achieving high-performance and reliable vertical power electronic semiconductor devices. The *PNDIODES* program will address one of the biggest road blocks for the viability of vertical GaN power electronic devices, namely, the lack of a GaN selective area doping or selective area epitaxial regrowth process that yields material of sufficiently high quality to enable a defect-free p-n junction on patterned GaN surfaces. Hence, the program will seek solutions that overcome the limitations of the current selective area doping technologies.

The overall goal will be to demonstrate randomly placed, reliable, contactable, and generally usable p-n junction regions in Gallium Nitride and other III-Nitrides for the purpose of enabling high performance and reliable vertical power electronic devices.

As described in more detail below, the purpose of this announcement is to facilitate the formation of new project teams to respond to the upcoming *PNDIODES* FOA. The FOA will provide specific program goals, technical metrics, and selection criteria; and the FOA terms are controlling. ***ARPA-E anticipates that the deadline for submission of Full Applications to this FOA will occur 60 days after its issuance.*** For purposes of the Teaming Partner List, the following summarizes current planning for the FOA:

The technical goals of the anticipated FOA will be centered on providing a pathway, based on fundamental science and technology, to fabricating high quality p-n junctions using selective area doping in Gallium Nitride and other III-Nitrides that are electrically equivalent to state-of-the-art as-grown p-n junctions. A secondary goal is the development of fundamental understanding of dopant incorporation, activation, diffusion, and defect passivation or elimination in the selectively doped regions along with an understanding of the impurities, defects, dislocations, and vacancies that are introduced by the selective area doping process. Efforts addressing a fundamental understanding of selective area doping must be clearly targeted toward developing actionable outcomes in addressing the goal of fabricating p-n junctions (using selective area doping techniques) that are electrically equivalent to state of the art as-grown p-n junctions with breakdown voltages exceeding 600V and commensurate forward characteristics on bulk GaN substrates.

Currently, ARPA-E anticipates that the FOA will target research in: (1) Selective area etching and epitaxial regrowth of doped regions using various growth techniques (MOCVD, MBE, etc.); (2) Ion implantation and



dopant activation using various annealing schemes (rapid thermal anneals, laser anneals, etc.); (3) Solid-state diffusion of dopants; (4) Neutron transmutation doping, (5) Other novel experimental or theoretical doping schemes and studies; and (6) Electrical and material characterization of the selective doped regions using various techniques (Hg-probe, I-V, C-V, TEM, AFM, EPR, RBS, cathodoluminescence, photoluminescence, XRD, X-Ray topography, sub-Å microscopy and atomic imaging, 3-D electron tomography, positron annihilation, etc.) and other novel diagnostic methods .

In order to realize the goals of the *PNDIODES* program, ARPA-E aims to bring together diverse engineering and scientific communities, including epitaxial growth specialists, semiconductor defect scientists, condensed matter theorists and experimentalists, electrical and nano-scale material characterization experts, chemists, semiconductor equipment engineers, semiconductor process specialists, and power electronics researchers.

As a general matter, ARPA-E strongly encourages outstanding scientists and engineers from different organizations, scientific disciplines, and technology sectors to form new project teams. Interdisciplinary and cross-sector collaboration spanning organizational boundaries enables and accelerates the achievement of scientific and technological outcomes that were previously viewed as extremely difficult, if not impossible.

The Teaming Partner List is being compiled to facilitate the formation of new project teams. The Teaming Partner List will be available on ARPA-E eXCHANGE (<http://arpa-e-foa.energy.gov>), ARPA-E's online application portal, starting **September, 2016**. The Teaming Partner List will be updated periodically, until the close of the Full Application period, to reflect new Teaming Partners who have provided their information.

Any organization that would like to be included on this list should complete all required fields in the following link: <https://arpa-e-foa.energy.gov/Applicantprofile.aspx>. Required information includes: Organization Name, Contact Name, Contact Address, Contact Email, Contact Phone, Organization Type, Area of Technical Expertise, and Brief Description of Capabilities.

By submitting a response to this Notice, you consent to the publication of the above-referenced information. **By facilitating this Teaming Partner List, ARPA-E does not endorse or otherwise evaluate the qualifications of the entities that self-identify for placement on the Teaming Partner List.** ARPA-E will not pay for the provision of any information, nor will it compensate any respondents for the development of such information. Responses submitted to other email addresses or by other means will not be considered.

This Notice does not constitute a FOA. No FOA exists at this time. Applicants must refer to the final FOA, expected to be issued in **October 2016**, for instructions on submitting an application and for the terms and conditions of funding.