Department of the Navy SBIR/STTR Transition Program

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NAVAIR 2019-953

Topic # N171-022
Novel High Energy Density Fuels Development
Advanced Cooling Technologies, Inc.

WHO

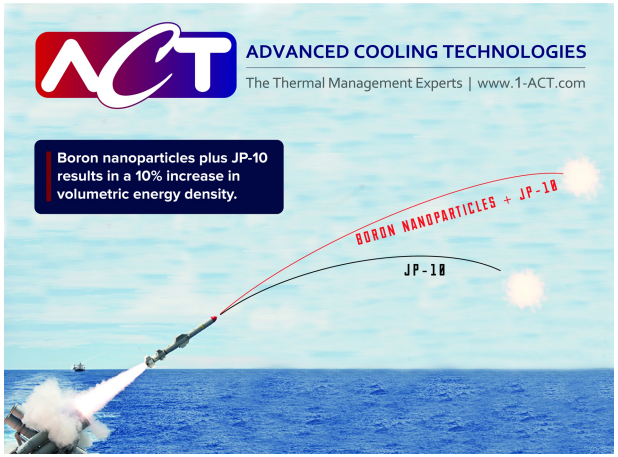
SYSCOM: NAVAIR

Sponsoring Program: U&W

Transition Target: PMA 201 is interested in liquid fuels to enhance the range of cruise missiles.

TPOC:
(760)939-0247

Other transition opportunities: High energy density liquid fuels can be applied to multiple missile systems.



https://www.navy.mil/view_image.asp?id=133562

Notes:

As shown in the graphic, missiles that utilize energy enhanced liquid propellants have the capacity to increase the stand-off distance between our forces and the enemy. ACT is working to add boron nanoparticle additives to JP-10 to increase its volumetric energy density by 10%, while maintaining low viscosity.

WHAT

Operational Need and Improvement:
The Navy desires a high density turbine fuel with a volumetric net heat of combustion that exceeds that of JP-10 by at least 10% and is less susceptible to thermal and oxidative degradation.

Specifications Required:
- Freezing point below -40°C, flashpoint above 60°C, pumpability at -40°C
- Thermo-oxidative stability comparable to or exceeding that of JP-10
- Fuel may be stored at temperatures ranging from -50°C to 50°C
- Fuel must function over a 30-year life span

Technology Developed:
- Addition of 8 vol% of boron nanoparticles increases energy density of JP-10 by 10%
- Plasma enhanced chemical vapor deposition (PECVD) coating applied to the nanoparticles prevents oxidation
- PECVD coating significantly lowers viscosity by reducing agglomeration.
- Exposure of boron nanoparticles to a low temperature hydrogen plasma reduces the degree of oxidation by >90%.
- By lowering the amount of boron oxide, a greater portion of the enhanced JP-10's energy density can be released upon combustion

Warfighter Value:
- 8 vol% boron in JP-10 produces a 10% increase in energy density which increases missile/platform range
- Similar viscosity, freezing point, and flash point allows for smoother engine assimilation; potentially eliminating the need to modify current engines
- For future R&D consideration, there is potential for boron nanoparticle additives to be used in other missile and rocket fuels (e.g. RJ-5)

WHEN

Contract Number: N68936-19-C-0015 **Ending on:** October 30, 2020

Milestone	Risk Level	Measure of Success	Ending TRL	Date
Stablize boron nanoparticle	Med	Dynamic light scattering will be performed on samples after sitting for hours, days, and weeks	4	October 2019
Eliminate boron oxide layer	Med	EDS quantification of the reduced ratio of boron oxide to native boron	4	October 2019
Deliver boron nanoparticle fuel	Med	Fuel succesfully characterization by the Navy	3	January 2020
Accelerate life testing	Low	Fuel stability over time after exposure to air, humidity, and thermal cycling	4	October 2020
Scale-up the PECVD reactor	Med	Increasing the reactor size, gas flow rates, and particle mixing mechanisms	5	July 2020
Deliver fuel	Med	Deliver 10 gallons of fuel for additional Navy characterization	4	October 2020

HOW

Projected Business Model:

Our goal is to maintain technical oversight of product development while licensing this technology to a Navy prime such as

- Aerojet Rocketdyne
- Lockheed Martin
- Northrup Grumman
- Raytheon

Company Objectives:

- Commercialize our technology within the Navy, specifically:
  * PMA 201
  * PMA 280
  * PEO U&W
- Expand technology to Air Force weapon systems
- Increase Foreign Military Sales

Potential Commercial Applications:

Highly unlikely there will be any applications for commercial aviation.

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