

WHO

**SYSCOM:** ONR

**Sponsoring Program:** General Warfighting Requirements (GWR)

**Transition Target:** Special Operations Forces (SOF) Navy divers

**TPOC:** Reggie Beach  
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**Other Transition Opportunities:** Military and civilian cold-water diving customers to include recreational, research, and oil cold-water divers.



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**Notes:** NanoSonic and Wetwear will adapt the overall design of the cold-water wetsuit based on the Navy Experimental Diving Unit (NEDU) compiled feedback from the Navy divers. Of significant interest will be adjusting the thickness, spacing, and location of the HybridSil thermal array wetsuit composites to achieve optimal combinations of thickness, insulation, buoyancy, and free-swimming maneuverability.

WHAT

**Operational Need and Improvement:** Most Special Operations Forces (SOF) diver training and operations is still done in wetsuits. For cold-water operations, and with basically all wetsuits being neoprene, hypothermia is a serious risk. Neoprene wetsuits provide very limited time at the surface and provide roughly 1/4 the insulation at 100 feet depth.

**Specifications Required:** A new wetsuit construction is desired, one that has R ratings in the single digits, comparable to a double air-gap of roughly R3-5. An innovative multi-layer approach (e.g., drop-stitch, additive manufacturing, multiple coveralls, outer fur) is sought that maintains a smaller gap or has stop-gap materials, which minimize thermal bridging, such that the R-value at 100-foot depth is 75% of the value at the surface. Innovative solutions to minimize flushing inside the wetsuit with cold ambient water will be most important. Mobility, and don and doff times should be comparable or better to those of current wetsuits. Solutions should not focus on gases composition within the gap, other than air, for ease of usage, maintenance, and repair.

**Technology Developed:** NanoSonic has created an innovative, commercially scalable wetsuit composite that integrates a heat reflective double air gap that has been empirically tailored to provide R-values as high as 4.0 ft².°F.hr/Btu and compressive resistance necessary for maintaining >75% of its insulative performance while under a compressive force simulating 100 feet of diving depth. NanoSonic iteratively designed and optimized a HybridSil polyurethane foam that deforms only 3.5% when compressed at 59 psia for 1-hour and is readily bonded to commercially available neoprene wetsuit foams.

**Warfighter Value:** NanoSonics compression resistant, highly insulative HybridSil wetsuit fabrics may be integrated into a variety of wetsuit designs through commercial seaming procedures to provide next-generation wetsuits that significantly reduce the likelihood of diver hyperthermia during extended missions in cold water environments.

WHEN

**Contract Number:** N68335-21-C-0739

**Ending on:** Sep 15, 2023

Milestone	Risk Level	Measure of Success	Ending TRL	Date
Process to manufacture wetsuit materials demonstrated	High	Material that passed thermal insulation and mechanical incompressibility fabricated in volumes large enough to make wetsuits, MRL 5	3	3rd QTR FY21
Design of first wetsuit using new materials completed	High	Wetsuit design demonstrated by performing fabrication steps on manufactured materials and producing sub-components	4	4th QTR FY21
First dive of a manufactured wetsuit	High	Dives completed over three days and for six hours each day to 100' depth and at water temperatures as low as 42°F -- minimum temperature on diver chest was 87°F	6	2nd QTR FY22
Navy testing of new wetsuits	High	Positive assessment of wetsuits by Navy divers	6	2nd QTR FY23

HOW

**Projected Business Model:** NanoSonic specializes in the design and manufacture of innovative materials, especially new materials that are currently unavailable in the commercial market. We design and manufacture materials with novel engineering behaviors with the overall goal to develop environmentally benign processes and techniques for these new materials. We have also developed new molecular self-assembly processes that allow the controlled synthesis of material structure at the nanometer level.

NanoSonic makes and sells custom fabrics and coatings and we currently sell similar materials to a glove manufacturer that makes first responder gloves that are fire-resistant and mechanically flexible. NanoSonic is working with Wetwear Inc., a major US manufacturer of custom wetsuits who has been in business for over 40 years. Our plan is to sell the wetsuit fabric and coating material to Wetwear, which will make the suits and sell them. Wetwear has an established customer base of DoD services, the Coast Guard, law enforcement and first responders.

**Company Objectives:** NanoSonic is partnered with Wetwear, and we're targeting the DoD, Coast Guard, Homeland Security, law enforcement, first responders, commercial industrial companies, and recreationalists for sales. Wetwear already sells wetsuits to all of these customer groups.

**Potential Commercial Applications:** Commercial variants would be suitable for recreational divers and use in the gas-oil industry or research community. Wetwear already sells wetsuits to customers in these market segments.