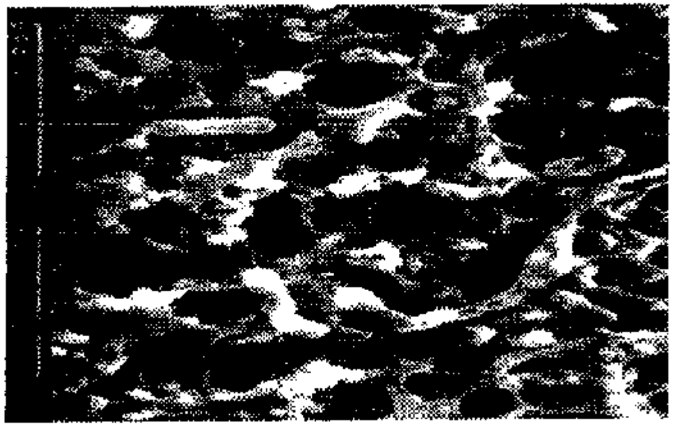
ANTI-MATERIEL BIOCATALYSTS & SENSORS



· Genetically engineered catalysts made by bacteria that detroy fuels, explosives, bio/chem weapons, etc (user defined)
· Can tolerate harsh delivery conditions

Potential Users: SOF, Peacekeeping forces, Counterdrug ops

Deliverables:
- Final report on effectiveness, health, safety, environmental impacts
- Proof of concept demonstration

Tasks:
· Engineer / demonstrate catalysts that destroy user defined substances
· Determine specific signature of catalyst to show it is working
· Determine reaction speeds and dose per amount target material
· Determine environmental impact

Cost/Schedule:
- $200K in FY98
  - Engineer biocatalysts specific for fuels
  - Lab demonstration
- $200K in FY99
  - Develop prototype for field demonstration
  - Conduct static field demonstrations

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Title of Submission: Anti Materiel Biocatalysts

Proposed Technology Investment:
Focus area 3 describes the use of non-lethal technology to stop land and sea vehicles and to neutralize facilities and equipment. The common thread to all these is that they require fuel to power them or to generate power to operate them. If one could develop a rapidly acting, highly efficient, and environmentally safe substance to destroy the lubricants or seize the mechanical parts, then the vehicles or facilities could be "shut down" in a controlled fashion. Armstrong Laboratory at Brooks AFB is well on the way to doing just that.

Over the past couple of years, the Biotechnology Branch of the Radiofrequency Radiation Division has been pioneering research to understand the mechanisms of RFR interaction and to develop quick, cheap, environmentally friendly way to clean up toxic substances. This work has led to the discovery of a patented process to genetically engineer catalysts specific to a particular substance (explosives, biological or chemical weapons, fuels, etc.). Heat, light, lasers, RFR activate the catalyst and initiate the reaction. The reaction creates enough heat to seize the engine or gunk the lubricants. The reaction has a unique luminescent signature so the destruction process can be remotely monitored (battle damage assessment) and does not produce any biohazards. The substance is exempt from biological warfare restrictions, can tolerate harsh delivery conditions, and is self amplifying (that is, a little goes a long way).

As an aside, this technology has application as a sensor. Intruders to restricted areas could be sprayed/painted and identified later (since the substance would luminesce under low RFR exposure). The technology could also be used to record cumulative exposure to RFR, something potentially useful for operators of high power RFR equipment or the soldier in an intense electromagnetic battlefield environment. The technology also has application in identifying friend or foe at long distances using the RFR sensitive substance on personnel or equipment insignia.

Potential for Joint Application: The application of this technology is limitless. Catalysts can be engineered to destroy whatever war materiel is desired. All Services would have an interest.

Technical Description: For the past 8 years Armstrong Laboratory has been conducting biotechnological research at the molecular level under AFOSR and, for the past 2 years, under SERDP support. These efforts led to the development of diazoluminomelanin (DALM), a biosynthesized catalyst, which interacts with a broad spectrum of optical and RFR, demonstrating enhanced reduction-oxidation (redox) activity including rapid breakdown of inorganic and organic hydrazines (rocket fuel) without fire or explosion. This controlled "burn" can destroy high energy materials as well as biological materials and plastics and other organic and bio-polymers. DALM has been biosynthesized on bacterial membranes in connection with existing imbedded enzymes. The work with

DALM is a baseline. This baseline could be extended to attach other biocatalysis and conjugates to alter specificity and reactivity of the redox reactions. Altered spectral signatures (absorbance and emissions in the visible and infrared ranges) could provide an unusual catalyst that marks its own presence and activity for sensor and monitoring activities. This proposal is to adapt these biocatalysts to the internal combustion reaction to bring about the destruction of the engine parts or polymerization of the lubricants to render the vehicles/craft useless for military purposes.

Risk Areas: The risks are minimal since what has been learned for cleanup applications under the AFOSR and SERDP programs would be extended to NLT applications. The catalyst synthesis process is well known. The unknowns are how much is needed to stop and engine, how to deliver it, and determining any environmental impact.

Timeline/Cost:

FY98: $200K
engineer catalyst that destroys fuels/stops combustion engine (1st and 2nd qtr)
determine specific signature of catalyst for monitoring (3rd qtr)
determine reaction speeds and dose for effect (3rd and 4th qtr)
conduct lab demonstration (4th qtr)

FY99: $200K
determine environmental impact of reactants and reaction products (1st - 4th qtr)
develop prototype for field demonstration (1st - 3rd qtr)
conduct static field demonstration (4th qtr)

Deliverables:

Final report on processes, effectiveness, environmental impacts, and results of demonstrations.

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