Project Summary/Abstract

This proposal is dedicated to the development of a new paradigm for the synthesis of materials with properties that don't exist in nature. The properties that will be incorporated into these solid state material are inspired by the behavior of biological materials which are part of important living data manipulation and storage systems. The specific properties that will be developed include; multiple states for fixed external conditions, sensitivity to external stimuli, threshold behavior for changing properties, fault tolerance, non-volatility, stochastic resonance, and low energy consumption for switching from one state to another.

The basis for these materials will be strongly correlated electron systems, which exhibit first order phase transitions in transport, structural, or optical properties. In order to engineer these properties, mesoscaled hybrid heterostructures will be artificially synthesized, extensively characterized, and deeply studied. A particularly important ingredient is the study of these materials under a variety of conditions which can modify their properties: incorporation in unique hybrid structures, stimulated by electric fields, currents, temperature, strain, and noise.

This type of materials will provide new functionalities non-existent yet in nature. Thus, they will provide a new class of materials, which will potentially become the basis for new high technology systems for electronics, sensors, data manipulation and storage. The PI's extensive experience and accomplishments in related areas form a solid basis over which to build such a program.

The basic research to be performed in this project will develop new ideas and concepts for materials needed in data manipulation and storage systems. Additionally it will provide the training ground for the next generation of scientists and technologists, will familiarize university researchers with defense needs and provide direct service for DoD.