科技部「臺美奈米材料基礎科學研發共同合作研究計畫」構想書

徵求公告修正說明(106.12.13)

徵求公告修正說明(以紅字標示)
一、計畫目標 本計畫為臺灣與美國空軍之國際合作計畫 (Taiwan/USAF Program on Nano-Structured Materials for Sensing and Sustainment)，107 年度為新啟始的三年雙邊合作計畫。本計畫聚焦在以下**六**個領域「Novel multifunctional materials」、「Materials for quantum phenomenon」、「Materials for flexible energy systems」、「Materials for infrared sensing/imaging」、「Predictive functional materials」、**「Bio-inspired materials for sensing」**，及與該**六**項領域相關的跨領域研究，以發展有潛力及未來性的研究。 *本徵求公告之訂定日期時間係以臺灣時間為準。
三、徵求內容 Focus will be on Nano-Structured Materials for Sensing and Sustainment. We will be seeking proposals dealing with the science in one or more of these 5 concentration areas: **1. Novel multifunctional materials** **2. Materials for quantum phenomenon** **3. Materials for flexible energy systems** **4. Materials for infrared sensing/imaging** **5. Predictive functional materials** **6. Bio-inspired materials for sensing** These concentration areas have potential applications in several possible systems for potential future transition. Examples to consider in each of the concentration areas are as follows: **1. Novel multifunctional materials:** advanced, high performance functional materials are the backbone of devices and components for applications we are interested in as well as the modern information technology industry. To advance on these fronts, emerging advanced functional materials (instead of multifunctional structural materials) are desirable for exploration. The focus areas are given below: a. High power/high frequency electronics: we would like to extend the operation range, bandwidth, and power handling of electronics in order to advance the performance of the devices/components for power and RF applications. It is desirable to study emerging materials with high structural order (i.e, single crystal) and low defect density (< ppm) for this area. b. High performance optoelectronics: it is desirable to explore new materials/concepts of optoelectronics to advance applications in communication, optical sensing, and optical

processing. A particular focus is on material hetero-integration for integrated photonics (i.e., on Si or other suitable semiconductor substrates).

c. Multi-physics materials/structures: this is an emerging field of which multi-physical responses are intertwined in ferrite heterostructures so that one may control a particular response through biasing a different one. For example, multiferroics typically uses a piezoelectric material as the substrate to mechanically strain a ferromagnetic material on top in order to tune the ferromagnetic resonance frequency. This type of novel concept is sought in this area.

2. **Materials for quantum phenomenon:** Quantum information is a highly active research area that offers unprecedented opportunities. A quantum network system is comprised of three main components: single photon generation, manipulation, and detection. The focus areas are given below.

   a. Single quantum emitters (SQEs): single quantum (photon) emitters, which emit one photon at a time with controllable quantum correlation, is a fundamental building block of quantum networks. The suggested research areas include but are not limited to solid-state SQEs, cold-atom SQEs, and nonlinear generation. It is encouraged to advance the fundamental understanding in order to improve the performance such as operating temperature, emission rate, conversion efficiency, electrical excitation, and collection efficiency, etc.

   b. Single photon manipulation: the suggested research areas include but are not limited to low loss single photon waveguide, single photon wavelength conversion, and quantum memory.

   c. Single photon detector (SPDs): SPDs are typically made by semiconductor avalanche photodiodes operating at or near room temperature or superconductor SPDs operating at liquid-nitrogen temperature or below. However, the avalanche photodiodes typically have lower efficiency than the superconductor SPDs. Therefore, it is desirable to improve the efficiency of avalanche photodiodes or increase the operating temperature of superconductor SPDs in this area.

3. **Materials for flexible energy systems:** this topic seeks novel materials/processing in flexible hybrid electronic packaging, printed/flexible batteries, flexible inorganic semiconductors, sensors (chem/bio, pressure, temperature), stimuli-responsive soft materials (mechanical responses driven by other stimuli such as light and voltage), and novel additive manufacturing for functional materials. Conventional energy devices such as photovoltaics and conventional batteries are not in the consideration.

4. **Materials for infrared sensing/imaging** While the infrared sensing/imaging technology has been matured for its performance in general, it is still desirable to offer low-cost alternatives in infrared sensing/imaging beyond Si CCDs and thermal detectors. Suggested techniques include but are not limited to: 1) low-cost thin film deposition – replace the high-cost MBE/MOCVD deposition with low-cost technique such as sputtering to achieve

respectable performance and large format at the same time; 2) Heterogeneous imager on Si substrate – reduce the cost by growing heterogeneous thin film on large Si wafers for infrared sensing/imaging; 3) low-cost material processing, e.g., colloidal quantum dots, soft materials, 2D materials, etc., for large format. Overall, we would like to see low cost material/processing while achieving large form factor and respectable performance at the same time.

5. **Predictive functional material:** we are looking for high throughput predictive modeling to design complex functional materials to scan the composition space to derive materials with favorable properties. For example, complex oxides are emerging materials for electronics and magnetics. Modeling is sought to predict oxides with large bandgap, high mobility, strong magnetization, etc. Another example is nonlinear crystal (NLC) for nonlinear optical generation or optical modulation. People general seek for high nonlinear coefficients, large optical damage threshold, or high electro-optical coefficients. Soft materials with good mechanical and electronic properties are also options for predictive modeling. All material sectors considered in the topics above are acceptable but we look for predictive modeling with scans through a whole sector space rather than one or two particular compositions.

6. **Bio-inspired materials for sensing:** Scientists and engineers have come to the conclusion that the natural world has the most efficient mechanisms for sensing. This topic covers two areas of interest:

a. New sensing platforms that integrate novel recognition elements, either bio-inspired (beyond antibodies) or artificially made, to advance sensing capabilities for biomarker monitoring in different bio fluids.

b. Also of interest is the discovery of new phenomena that can be utilized to characterize the affinity of new recognition elements in a high through-put fashion with preference for label-free approaches.

Specific areas of interest can be also found in the AFOSR Broad Agency Announcement (BAA-AFRL-AFOSR-2016-0007) at http://www.grants.gov/search/search.do

五、申請作業與審查流程

構想書申請期限及送達方式：申請人請循本部學術研發服務網登入「申辦項目/專題研究計畫／臺美奈米材料基礎科學研發共同合作研究計畫構想書」線上申請方式作業，**申請截止日期為 107 年 1 月 29 日。**

申請人於系統繳交送出後，顯示「計畫狀態：繳交送出(科技部)」。

本階段我方申請案**不須**經申請人任職機構於系統中彙整後送出。

請注意：除上開**紅字**標示之處，其餘徵求公告內容**不變**。

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