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

(Taiwan/USAF Program on Nano-Structured Materials for Sensing and Sustainment)

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。

二、申請條件

(一) 符合「科技部補助專題研究計畫作業要點」規定者。

(二) 主持人計畫件數之計算

- 係依據本部補助單一計畫主持人計畫件數核給基準，申請人請務必先自行確認其計畫件數符合規範原則之上限。除情形特殊者外，計畫核定通過後不得於執行期間變更計畫總主持人或中止計畫之執行。
- 本徵求計畫不計入「研究案」計畫件數，惟須併入「雙邊協議專案型國際合作研究計畫」計算，同時間「雙邊協議專案型國際合作研究計畫」件數不得超過 2 件。
- 承上，若申請人目前已有 2 件本部「雙邊協議專案型國際合作研究計畫」，且其計畫執行日期均與本次徵求案之預定執行迄日達 3 個月以上重疊者，本部得以不受理辦理補助。

(三) **合作對象：需包含 1 個(含)以上的美方研究人員。該美方研究人員之服務機構，必須為美國學術研究單位或美國國防部(DoD)之受補助實驗室。如對美方研究人員資格有疑問，請與本案美方負責人員聯絡。美國空軍聯絡人：**Lt. Col Sheena L Winder, PhD; Email: sheena.winder@us.af.mil

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

四、計畫類型

(一) 個別型計畫：由計畫主持人依研究專長及本徵求公告之計畫目標研提計畫。

(二) 單一整合型計畫：包含總計畫及子計畫，由總計畫主持人依本徵求公告之計畫目標組成研究群，研提跨領域或跨校之計畫，或就特定題目自行組成

研究群研提之計畫。

五、申請作業與審查流程

本計畫申請區分「構想書(Pre-proposal)」及「完整計畫書(Full-proposal)」兩階段，由臺美雙方共同審查。**臺美雙方之申請人，必須分別向其補助機構依規定提出申請書**，以下為臺方申請人應注意之事項。

1. 構想書格式：如附件。
2. 申請件數：每人以申請 1 件為限，且相同研究計畫內容，不得重複向本部或其他機構申請補助。
3. 計畫執行期限：民國 107 年 8 月 1 日至 110 年 7 月 31 日，共 3 年。
4. **經費編列說明**
   (1) 補助金額：博士後研究人力與計畫研究所需經費，**合計補助總金額上限以 300 萬元/年為原則**。本計畫經費係專款專用，未獲補助案件不接受申覆。
   (2) 注意事項：**計畫主持人配合臺方與美方之相關規劃，進行年度或期末成果簡報致使產生業務費、國外差旅費等相關支出，由該計畫經費項下勻支，不得另案再向本部申請。**
   (3) 如有未盡說明之處，請依本部專題研究計畫作業要點與專題研究計畫經費處理原則等相關規定辦理。
5. 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。
6. 構想書審查方式：**確定臺美雙方之申請人皆符合申請資格後，申請人需至本部進行簡報並接受詢答。**本部自然司將以**電子郵件**通知申請人簡報日期與地點，未進行簡報者，其申請案不予推薦。本計畫經費係專款專用，無申覆機制。
7. **審查重點：**
   - 研究內容必須具有創新性，著重於基礎科學原創性研究。
   - 雙邊合作的必要性。
   - 具發展潛力及未來性。
8. 構想書審查結果通知：構想書審查獲推薦者，將由本部自然司**暫訂於 107 年 2 月 14 日(星期三)前正式行文通知申請機構與申請人**於期限內(暫訂 107 年 4 月 3 日前)提送完整計畫書(Full-proposal)，並造具申請名冊備函送達本部。前述完整計畫書(Full-proposal)之格式待構想書審查獲推薦時一併通知。
9. 構想書審查獲推薦者，其具體計畫書之計畫主持人、計畫題目及計畫目

標應與構想書相符，不得隨意變更。若因特殊因素需申請前述之變更者，計畫申請人應提出變更之原因，經審查並決議同意變更後，始得變更。

六、成果報告繳交、審查及評鑑

計畫主持人除依本部規範繳交研究成果等報告外，應於全程期末配合本部辦理成果審查等計畫評鑑作業。計畫主持人亦須配合臺方與美方之相關規劃，進行年度或期末成果簡報。

七、聯絡資訊

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