用於結構健康監測的噴塗式智能傳感器網絡

Sprayable Smart Sensing Network Coating for Structural Health Monitoring

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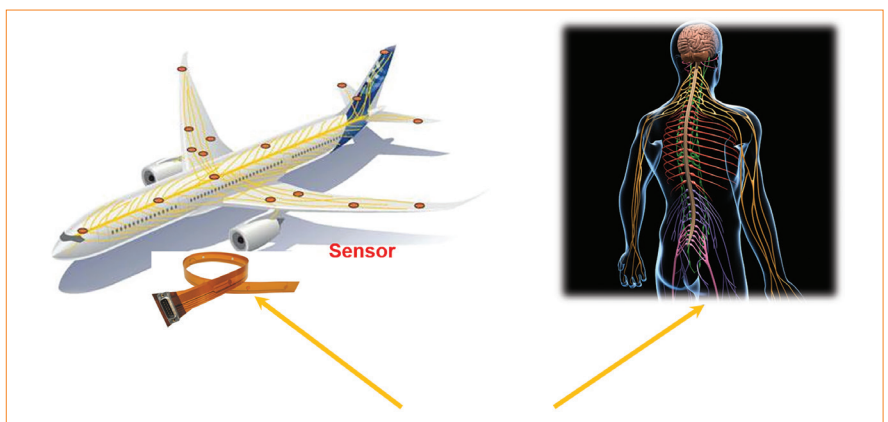
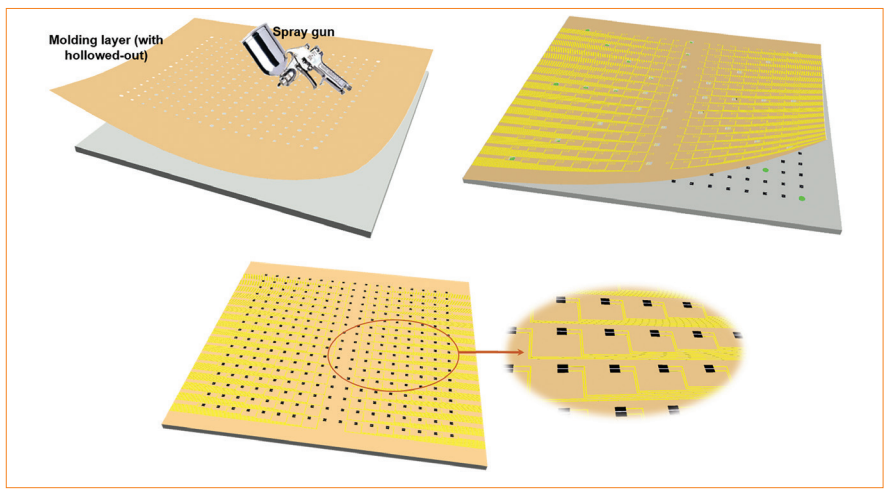
應用於實時工程結構健康監測的新型、超輕、超柔、高敏感納米複合材料傳感器網絡

Smart sensing network coatings made with new breed of nanocomposites for in-situ health monitoring of engineering structures and assets

這種嶄新的納米材料傳感器由新型納米複合材料製成，其成份包括碳黑、二維石墨烯及聚偏二氟乙烯。該傳感器可被直接噴塗於任何待檢結構表面，形成獨特的智能傳感器網絡，可以接收1兆赫或以下的超寬頻率信號，藉此偵測損毀。此納米傳感器網絡不單輕巧、可屈曲，且反應快速，能對肉眼看不出的微小瑕疵或損毀(例如因金屬疲勞而產生的裂紋)進行定量評估。這種創新技術從根本上改變現有超聲波傳感理念，為今後的實時結構監測開創新的方向。



使用大規模傳感器網絡進行實時在線的結構健康監測
Real-time, in-situ, online structural health monitoring using large-scale sensor network



可直接噴於結構上作實時健康監測的大規模傳感器網絡
Large-scale, sprayable, in-situ sensing network coating that can be sprayed onto the structure directly

This innovative, first-ever, nanocomposites-inspired smart sensor is made of carbon black (CB), 2D graphene and polyvinylidene fluoride (PVDF). The sensors made of this new breed of nanocomposites can be directly sprayed on any engineering structure to form a highly dense smart sensing network, which can acquire in-situ broadband ultrasounds of up to 1 MHz for damage detection. Lightweight, flexible and highly responsive, the sensing network can quantitatively evaluate invisible, undersized defect and damage in the structure, such as cracks caused by metal fatigue. This new sensing technology retrofits conventional ultrasonic sensing philosophy, and blazes a new trail for next generation of in-situ structural health monitoring.

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Access More info via mobile
Note: Subject to data charges by mobile operators

專利編號: US 9,863,824 B1 (美國),專利申請編號: US 2018/0045588 A1 (美國)

特色與優點

- 良好的物理特性：輕巧、可屈曲及可裁剪
- 優秀的信號接收特徵：保真度高，反應迅速，靈敏度高
- 超寬的信號頻域：可以感應靜態至1MHz的高頻信號，以檢測極微小的損毀
- 易加工：可噴塗和快速成型

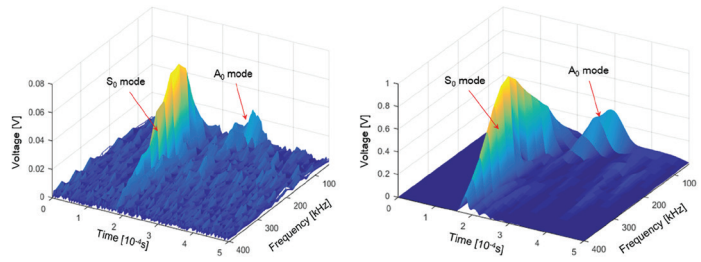
應　用

- 交通工具的結構健康監測，如飛機及車輛
- 土木工程結構的健康監測，如橋樑
- 太空儀器的健康監測，如人造衛星

獎　項

- 第46屆瑞士日內瓦國際發明展 - 金獎 (2018年4月)
- 泰國國家研究評議會特別獎 (2018年4月)

超輕、超柔和可定制的智能傳感器材料
Lightweight, flexible and tailorable smart sensor material



Spectra of broadband ultrasound signals (2 kHz-500 kHz) upon noise-filtering, captured by nanocomposite film sensor (left), and by PZT wafer (right) (S0 and A0: zeroth-order symmetric and anti-symmetric Lamb wave modes, respectively)

超寬的信號頻域
Broadband frequency sensing range

Patent No.: US 9,863,824 B1 (US), Patent Application No.: US 2018/0045588 A1(US)

Special Features and Advantages

- Good physical properties: lightweight, flexible and tailorable
- Excellent signal characteristic: high fidelity, quick response, high sensitivity
- Broadband sensing range: from static to up to 1 MHz for detecting hairline damage such as tiny fatigue cracks
- Easy processing: sprayable and rapid curing

Applications

- Health monitoring for vehicles, such as aircrafts and automobiles
- Health monitoring for civil engineering structures, such as bridges
- Health monitoring for aerospace devices, such as satellites

Award

- Gold Medal – 46th International Exhibition of Inventions of Geneva, Switzerland (Apr 2018)
- Special Merit Award from the National Research Council of Thailand (Apr 2018)

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