附件四、技術說明表

請於此欄位填寫發明名稱

雲母基板上成長自我分離氮化鎵厚膜之製程與方法

提案人：周苡嘉 教授

單 位：國立臺灣大學 材料工程學系/研究所

簡 歷：https://yichiachou.wixsite.com/chou-group

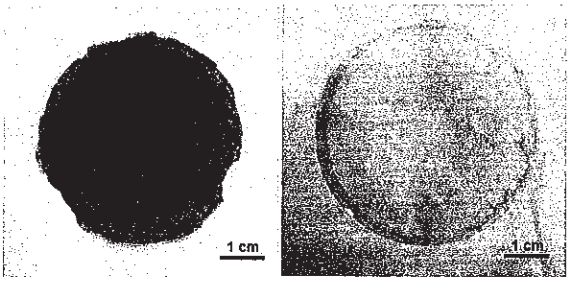
市場及需求:

傳統上，氮化物元件磊晶在sapphire、Si和SiC基板上，而sapphire是使用率最高的基板，然而這些磊晶方法會導致晶格不匹配進而造成缺陷。如果在氮化鎵基板上進行氮化鎵磊晶，則可以大幅度的改善元件的性能。由於氮化鎵基板製程較困難且成功率較低，因此氮化鎵相關元件品質的製作較為難提升。雖然TDI、先進材料、Cree等公司已實現氮化鎵單晶基板的商品化，然而氮化鎵基板製程屬於高資本的製程，是氮化鎵基板市場增長的最大阻礙；因此，市場仍將被異質基板所佔據，其中氮化鎵基板塊材僅佔較小的比例。由於數十億美元的市場（如物聯網和電動汽車市場）準備使用氮化鎵基板塊材，因此簡易高成功率的氮化鎵基板製程有潛力佔據大部分氮化鎵基板的市場。

技術摘要(含成果):

成長自我分離式的氮化鎵厚膜的方法有很多種，目前自我分離式基板選用碳化矽及氧化鋁基板，但這些基板不僅價格較高、製作大面積的氮化鎵製程繁瑣耗時而且製成功率不高。我們使用的人工雲母基板較便宜，除了可以承受高溫製程和酸鹼環境，磊晶完的氮化鎵厚膜還能輕易的自我分離，而自我分離率能近乎百分之百; 除此之外，使用過後的人工雲母可以經過適當的處理再次使用，大幅度降低製造氮化鎵基板的成本，提供自我分離式的氮化鎵厚膜新的基板選擇。

自我分離後的氮化鎵塊材和人工雲母基板



優勢:

目前大多數成長自我分離的氮化鎵厚膜的基板都選擇氧化鋁、碳化矽和矽基板，然而在這些基板上的自我分離流程都較繁複費時且成功率不高。我們發現人工雲母除了成本低以外，其耐熱性、耐酸鹼性和化學穩定性等都適用於成長氮化鎵，除此之外，由於人工雲母和氮化鎵介面是透過凡德瓦爾力磊晶，可以降低人工雲母與氮化鎵之間晶格匹配度差異所造成的影響，而氮化鎵成長於雲母方面的文獻極少，為自我分離氮化鎵技術提供了新的基板選擇。

競爭產品:

其他製程方式所製作的分離式氮化鎵厚膜

專利現況:

(1)本研究團隊具有數年研究經驗

聯絡方式(請不用填):

臺大產學合作總中心

Tel: 02-3366-9945, E-mail: ordiac@ntu.edu.tw

Title of Invention

Process and method for self-separation gallium nitride thick film on mica substrate

PI：Prof. Yi-Chia Chou

Department of Material Science and Engineering, National Taiwan University.

Experience: https://yichiachou.wixsite.com/chou-group

Market Needs:

Traditionally, GaN devices have been epitaxially grown on sapphire, Si and SiC substrates, with sapphire being the most used substrate, however these epitaxial methods can lead to lattice mismatch and thus defects. If GaN epitaxy is performed on a GaN substrate, the performance of the device can be greatly improved. Since the GaN substrate manufacturing process is difficult and the success rate is low, it is difficult to improve the quality of GaN-related components. Although TDI, Advanced Materials, and Cree have realized the commercialization of GaN single crystal substrates, the GaN substrate manufacturing process is a high-cost process and is the biggest obstacle to the growth of the GaN substrate market; therefore, the GaN growth market is still dominated by heterogeneous substrates, of which bulk GaN substrates only account for a small proportion. Multi-billion dollar markets such as IoT and electric vehicles are poised to use bulk GaN substrates, and therefore, the simple and high-success rate process of self-separation bulk GaN has the potential to occupy most of the GaN substrate market.

Our Technology:

At present, the substrates for self-separation GaN usually use SiC and sapphire, but these substrates are not only expensive, but also difficult and time-consuming to produce large-area GaN. The artificial mica substrate we use is relatively cheap. In addition to being able to withstand high temperature process and acid environment, the GaN thick film can be easily self-separated, and the self-separation rate can be nearly 100%; in addition, after use the artificial mica can be reused after proper treatment, greatly reducing the cost of manufacturing GaN substrates, providing a new substrate option for self-separating GaN thick films.

Strength:

At present, most of the substrates for producing self-separated GaN thick films are sapphire SiC and Si substrates. However, the self-separation process on these substrates is difficult and time-consuming and the success rate is low. We observed that artificial mica has cheap cost, heat resistance, acid and alkali resistance and chemical stability, which are appropriate for producing bulk GaN. It may lessen the effect of the difference in lattice matching between artificial mica and GaN, and there is less literature on the development of GaN on mica, which expands a new choice of substrate for GaN self-separation technology.

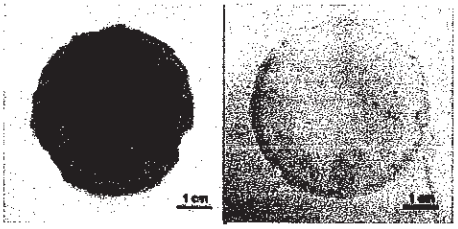
Competing Products:

Free-standing GaN thick film separated by other processes

Intellectual Properties:

The research team has several years of research experience

Bulk GaN and artificial mica substrate after self-separation



Contact (do not need to fill out):

Center for Industry-Academia Collaboration, NTU

Tel: 02-3366-9945, E-mail: ordiac@ntu.edu.tw