附件四、技術說明表

製造六方氮化硼薄膜之方法

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市場及需求:
隨著半導體技術持續微縮至奈米尺度，晶片效能受限於金屬互連結構內寄生電容及電阻所造成的延遲與功耗增加，成為迫切需要解決的問題。氮化硼(BN)因具備低介電常數及良好的化學穩定性，尤其是六方氮化硼(h-BN)與非結晶氮化硼(a-BN)，被視為未來低介電常數材料之重要候選材料，其市場潛力巨大。

技術摘要(含成果):
本發明提出一種創新的原子層沉積(ALD)方法，製備具高結晶品質之六方氮化硼(h-BN)與非結晶態氮化硼(a-BN)薄膜。研究顯示，此方法可於低溫下實現高沉積速率並具有優異晶體結構，其中 a-BN 薄膜之介電係數可低於 2。

優勢:
1. 低溫下即可實現優異結晶品質及高生長速率，顯著降低製程成本與能源消耗。
2. a-BN 薄膜具低介電係數。
3. 大幅提高薄膜成長速率，突破傳統 ALD 製程瓶頸。
4. 薄膜可靠性高，具有極佳的擊穿強度與長期穩定性。

競爭產品:
傳統競爭技術如化學氣相沉積(CVD)及一般 ALD 技術，往往需要高溫(750~1500°C)才能獲得良好晶體結構與薄膜品質，或是前驅物反應性低、生長速率慢。本專利方法在低溫環境下即能製備優異特性的氮化硼薄膜，克服現有技術之缺陷，具有明顯的市場競爭優勢。

專利現況:
本研究團隊於原子層沉積技術開發已具有多年研究經驗，目前就此專利技術進行原型模組架構測試與沉積測試。該專利目前申請中。

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METHOD OF MANUFACTURING HEXAGONAL BORON

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Market Needs:
As semiconductor devices scale down to nanometer dimensions, parasitic capacitance and resistance in metal interconnects increasingly degrade chip performance, resulting in signal delays and high power consumption. Boron nitride (BN), particularly hexagonal BN (h-BN) and amorphous BN (a-BN), offers excellent chemical stability, and ultra-low dielectric constants, making it a promising material to mitigate these challenges.

Our Technology:
This invention proposes an innovative atomic layer deposition (ALD) method for depositing high-crystallinity hexagonal boron nitride (h-BN) and amorphous boron nitride (a-BN) thin films. This method enables high deposition rates at low temperatures while achieving excellent crystal structures. Notably, the dielectric constant of the a-BN films can be reduced to below 2.

Strength:
1. High crystalline quality and growth rate can be achieved at low temperatures, significantly reducing process costs and energy consumption.
2. BN thin films exhibit a low dielectric constant.
3. The film growth rate is substantially improved, overcoming the limitations of conventional ALD processes.
4. The films demonstrate high reliability, with excellent breakdown strength and long-term stability.

Competing Products:
Conventional competing technologies, such as chemical vapor deposition (CVD) and standard atomic layer deposition (ALD) methods, typically require high temperatures (750–1500 °C) to achieve good crystalline structure and film quality, or suffer from low precursor reactivity and low growth rates. This patented method enables the deposition of high-quality boron nitride thin films at low temperature temperatures, overcoming the limitations of existing techniques and offering a clear competitive advantage in the market.

Intellectual Properties:
The research team has extensive experience in atomic layer deposition (ALD) development and is currently engaged in prototype system integration and deposition performance testing of the patented technology, which is currently under patent application.

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