**Structural properties of Ga₂O₃ thin films grown via dc-pulsed magnetron sputtering using a liquid gallium target**

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Our research has been dedicated to investigating the potential of dc-pulsed magnetron sputtering for the preparation of gallium oxide (Ga₂O₃) as a semiconductor material suitable for high-power and high-frequency applications. Ga₂O₃ is notable for its ultra-wide bandgap of approximately 4.8 eV, high electron saturation velocity, and its ability to withstand a high breakdown electric field of about 8 MV/cm. While epitaxial techniques for growing high-quality β-Ga₂O₃ films have advanced considerably, they still suffer from low deposition rates, which limit scalability.

Our primary objective was to enhance the crystal quality of Ga₂O₃ films produced by dc-pulsed magnetron sputtering - a method known for its high deposition rate but typically challenged by the formation of well-ordered crystalline structures. An advantage of this method lies in the ability to tune oxidation conditions during growth via discharge parameters, which have a significant impact on the resulting film properties.

We focused on reactive magnetron sputtering of Ga₂O₃ films from a liquid gallium metal target. The resulting film quality and characteristics were strongly influenced by several key factors, particularly the substrate temperature and the choice of substrate material—quartz, silicon, and sapphire. Our study aimed to understand how these variables affect film structure and to optimize deposition conditions for practical applications.

We successfully deposited crystalline Ga₂O₃ films exhibiting a strong preferential orientation. Our experiments revealed that increasing the substrate temperature promoted crystallization, but also unexpectedly diminished the strength of the preferred orientation. To explore this further, we studied the effect of varying the pulse length in the dc-pulsed sputtering process and analyzed how it shaped the resulting film structure. These experiments were conducted across different substrates, showing that the choice of substrate plays a critical role in determining the final microstructure of the Ga₂O₃ films.