Atomic Layer Deposition of Lanthanum Oxide Using New La precursors

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The continuous scaling of memory devices has led to challenges such as reliability issues due to leakage current and high power consumption. Lanthanum oxide (La_2O_3) is emerging as material for advanced memory devices because of its superior properties. For example, La_2O_3 is considered one of the promising materials for gate dielectrics due to its high dielectric constant (~27), wide bandgap (5.8~6.0eV), and thermodynamic stability in direct contact with Si. In addition, La_2O_3 is used as a dipole layer to adjust the effective work function of high-k metal gates, thereby reducing the threshold voltage. [1], [2]

Atomic layer deposition (ALD) is one of the most practical tools for advanced gate dielectric formation due to its precise thickness control, high uniformity and conformality. Air Liquide has developed three La precursors (La1, La2 and La3). Among them, La1 exhibits promising physical properties, including high vapor pressure and excellent thermal stability, making it a promising candidate for the ALD process. ALD evaluation was performed using La1 and ozone as the co-reactant. ALD window was observed up to approximately 350ºC, with a GPC >1A/cycle. Additionally, good step coverage (>90%) was achieved at 180 °C (S/C >90%, A/R=1:25). Carbon content within the films was dramatically reduced through a post-annealing process in the Ar atmosphere at 550°C for 10 minutes.

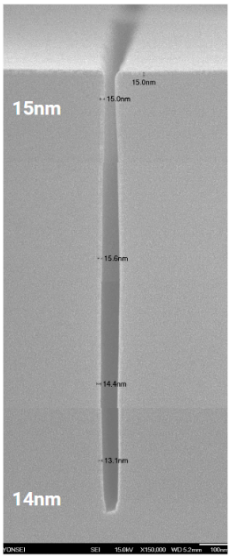

Fig 1. Step coverage by using La1 with O_3 at 180 ºC

Reference

[1] Journal of the Korean Physical Society, 2002, 41(6), 998-1002.

[2] Microelectronic engineering, 2011, 88(12), 3385-3388.