Atomic layer deposition of HfO_2 thin film using a novel linked cyclopentadienyl-amido Hf precursor

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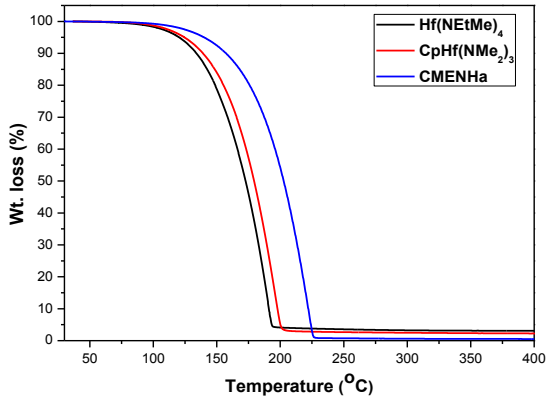
Hafnium oxide (HfO_2) is presently considered as one of the most promising candidates for alternative gate oxide insulating layers in CMOS (complementary metal oxide semiconductor) devices because of its thermal stability, high permittivity, and relatively large bandgap. Other possible applications for HfO_2 thin film include DRAM (dynamic random access memory) capacitors and optical coatings. In this study, we introduce a novel linked cyclopentadienyl-amido Hf precursor, CMENHa. Also, we compared the properties of the HfO_2 thin film of CMENHa to those of $CpHf(NMe_2)_3$ grown by atomic layer deposition (ALD).

The physical characteristics of CMENHa, $CpHf(NMe_2)_3$ and $Hf(NEtMe)_4$ were investigated by NMR and viscometer. It was notable that the viscosity of CMENHa was similar to $CpZr(NMe_2)_3$. The thermal stability of CMENHa was also investigated by thermogravimetric analysis (TGA). The amount of residue was about 0.6% for CMENHa, which had a less residue compared to $CpHf(NMe_2)_3$ (2.5%) and $Hf(NEtMe)_4$ (3.2%). The ALD characteristics of CMENHa compare to $CpHf(NMe_2)_3$ will be discussed in the conference. Based on suitable viscosity and good thermal stability, the CMENHa is expected to be promising precursor for insulating layer in gate oxide and DRAM capacitors.

(a)



(b)

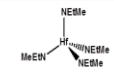
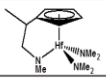
Product name		$Hf(NEtMe)_4$	$CpHf(NMe_2)_3$	CMENHa
Structure				
Molecular weight		410.90 g/mol	375.81 g/mol	401.85 g/mol
Phase at 25℃		Pale yellow liquid	Colorless liquid	Pale yellow liquid
Boiling point		79 ℃ @ 0.1 torr	81 ℃ @ 0.1 torr	110 ℃ @ 0.25 torr
TG	T ½ (℃)	173	179	203
	Residue (%)	3.2	2.5	0.6

Figure 1. (a) Thermogravimetric analysis of Hf precursors, (b) Physical characteristics of Hf precursors