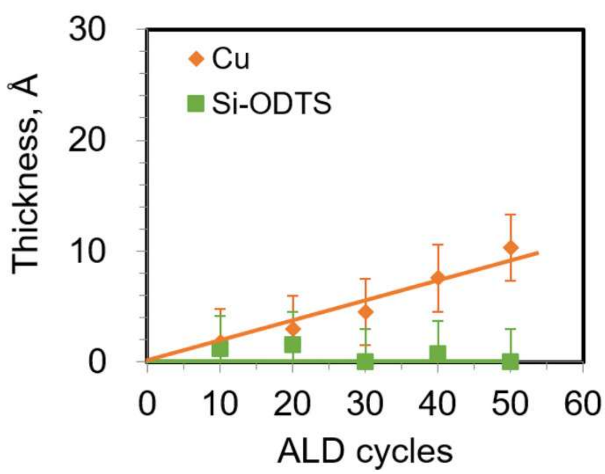
ARRADIANCE *Sneak Preview*

Pushing the Boundaries of Area-Selective ALD for Next-Gen Semiconductors

December 17, 2025

Area-selective deposition techniques are advancing development of increasingly complex semiconductor devices. Researchers from Adeka Corporation and Hokkaido University explored a new approach to area-selective atomic layer deposition (ASALD) of aluminum oxide (Al_2O_3). They focused on improving selectivity using an aluminum precursor with large ligands, dimethyl(isopropylamidinate)aluminum [$AlMe_2$(iPr-AMD)]. The team used an Arradiance Gemstar™ ALD system to carry out their experiments.

The most common precursor for ALD of Al_2O_3, TMA, is a very reactive, small molecule. While this allows it to coat almost any surface, this is not desired in ASALD. $AlMe_2$(iPr-AMD) is less reactive than TMA. Due to its large ligands, it is more effectively blocked by self-assembled monolayers (SAMs). The researchers also evaluated the thermal stability of $AlMe_2$(iPr-AMD), finding decomposition beginning at 367 °C by differential scanning calorimetry. Its non-pyrophoric nature makes it safer to handle than TMA.



The thickness of Al_2O_3 films on Cu and ODTS-treated SiO_2

To test selectivity, they deposited Al_2O_3 onto copper and silicon oxide surfaces at 150 °C. They applied (SAMs) as inhibitors prior to the ALD process. For dielectric-on-dielectric processes, they applied a 1-dodecanethiol SAM to copper, which blocked growth on Cu while allowing films to grow on native silicon oxide. For dielectric-on-metal processes, they treated silicon with octadecyltrichlorosilane, which suppressed growth on SiO_2 while leaving Cu unblocked. In both cases, $AlMe_2$(iPr-AMD) worked as intended: films grew only where SAMs allowed.

By combining large precursors like $AlMe_2$(iPr-AMD) with SAMs, ASALD can deliver precise alignment of films while skipping a complex lithography step. The work highlights $AlMe_2$(iPr-AMD) as a promising candidate for ASALD of Al_2O_3 in advanced semiconductor manufacturing.

Arradiance supports a broad range of research requiring ALD solutions. For more information on GEMStar™ Technology, ALD systems or Foundry services, please contact Arradiance.

[1.] *Akihiro Nishida et.al., " Area-selective atomic layer deposition of Al2O3 film on Cu and Si substrates using bulky Al precursor AlMe2(iPr-AMD)". J. Vac. Sci. Technol. A, 43(5) Sep/Oct 2025;* https://doi.org/10.1116/6.0004806