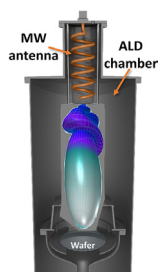


5 September 2025

Microwaves improve thin film deposition technique

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Films exposed to microwaves during atomic layer deposition showed improved properties.



Atomic layer deposition (ALD), a self-limiting thin film deposition technique, is widely used to create advanced devices for use in batteries, solar cells, biomedical applications, and the semiconductor industry. Due to the low deposition temperatures, ALD films can suffer from increased impurities that can compromise film properties. Energy enhanced atomic layer deposition (EE-ALD) has been used to improve film properties, but the various methods to date have drawbacks such as increased processing time or cause plasma or UV damage. Improving on EE-ALD, Kupp et al. developed microwave enhanced ALD (MW-ALD).

“The idea is that the microwave exposure could be used to quickly anneal the film as it is growing, removing impurities and repairing defects before they can become buried,” said author John Conley Jr.

The researchers designed a microwave antenna that could fit into an ALD chamber and tuned it to reduce power wastage. Using aluminum oxide, which doesn't interact with microwaves in bulk form, the MW-ALD method was tested by exposing the film to microwaves during deposition.

The results showed improvements in the film properties compared to standard thermal ALD. Additionally, the timing of the microwave exposure could be used to produce larger changes in film thickness and properties.

“With the potential for direct interaction with polarizable defects and impurities and minimal substrate heating, MW-ALD is a promising new form of EE-ALD that merits further investigation for use in the semiconductor industry, particularly in the back end of line where high quality films at low thermal budget are needed,” said Conley Jr.

The researchers are continuing to test MW-ALD with other materials. They hope to optimize microwave exposure for different materials and understand how the microwaves interact with the film.

Source: “Microwave enhanced atomic layer deposition (MW-ALD): Incorporating a microwave antenna into an ALD system and performing *in-situ* direct microwave exposure during ALD,” by Benjamin Kupp, Jessica Haglund, Shane Witsell, Mohammad Kamarehi, and John F. Conley Jr, *Journal of Vacuum Science & Technology A* (2025). The article can be accessed at <https://doi.org/10.1116/6.0004633>.

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