

About the importance of purge time in molecular layer deposition of alucone films

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The deposition rate and properties of MLD films are for a large part determined by what happens during the precursor exposure. In some cases, however, the purge step is of equal importance, for example in the MLD of alucone films using trimethylaluminum (TMA) and ethylene glycol (EG). These alucone films tend to be porous in nature due to which the reactants during their exposure step not only react at the film surface but also tend to infiltrate into the film. The outgassing of the infiltrated reactant can take relatively very long thereby becoming the deposition rate limiting step. If enough purge time is not provided for the reactant to outgas, it will lead to an undesirable CVD component alongside MLD in the overall growth. We have investigated the MLD of alucone focusing on the effect of purge time of TMA on the growth kinetics. To avoid any negative impact of the CVD component on the deposition rate and the film's properties, we have also developed a kinetic model to correlate parameters like exposure times, partial pressures, purge times and deposition temperature to the CVD component in the growth. Finally, we show that using a bulkier precursor like DMAI instead of TMA can overcome the problem of precursor infiltration and increase the deposition rate of alucone processes by at least an order of magnitude.

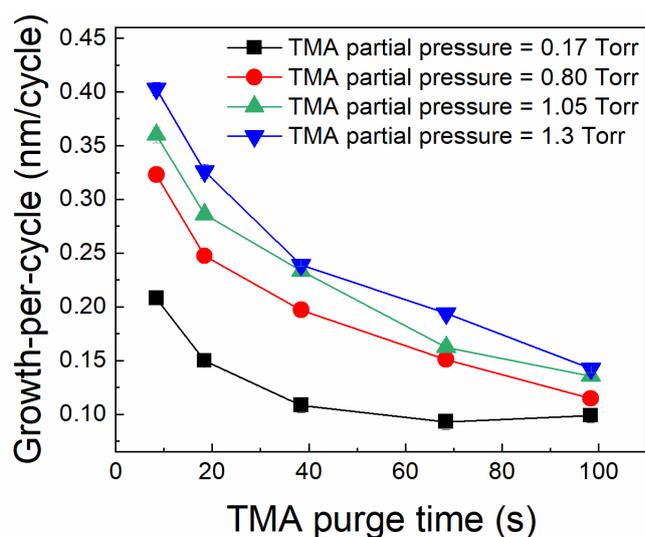


Figure 1: Growth-per-cycle (GPC) of the TMA + EG alucone MLD as a function of TMA purge time. In these experiments conducted at 150 °C, the EG dose and purge time were kept constant while the TMA purge time was varied. For each TMA partial pressure, the GPC decreases with increasing TMA purge time and upon long enough purge stabilizes at a steady state value.