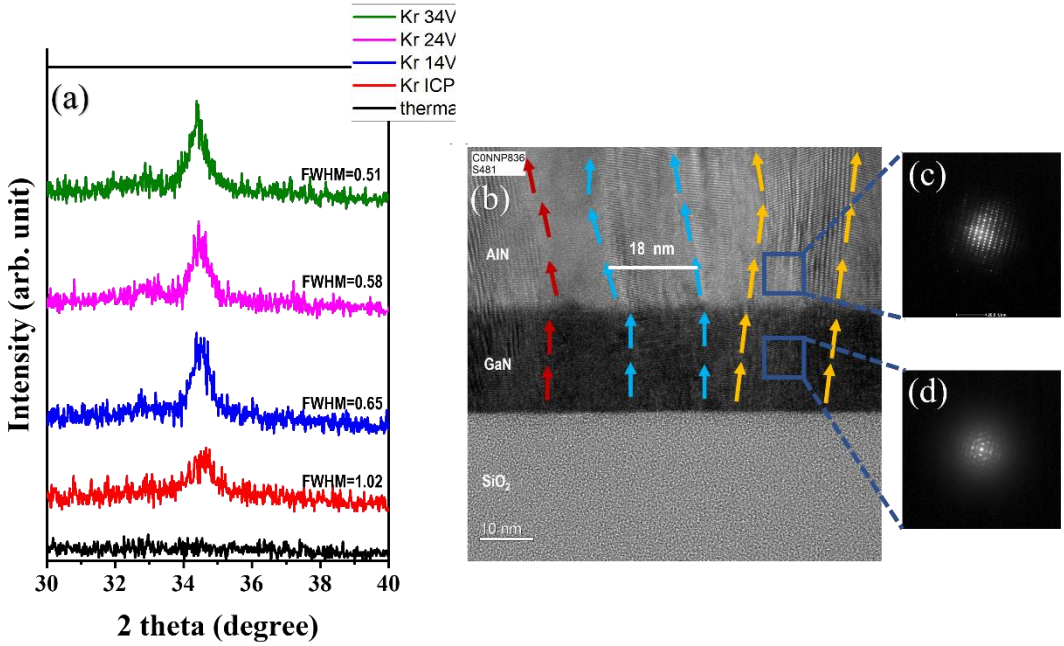

Fig 1. Film Characterization (a) GIXRD of GaN deposited by various ALD-based methods. (b) TEM of the AlN sputtered films deposited on top of ALA -24V substrate biasing GaN and the corresponding AlN electron beam diffraction (c) and GaN electron beam diffraction (d). RF-biased processes produce more intense ion collisions and demonstrates stronger crystallinity. The extension of grain structure shows that this low-temperature growth GaN serves as a good template for room-temperature sputtered AlN.

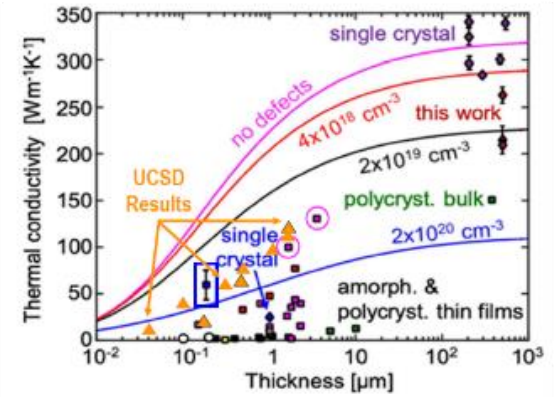

Fig. 2 Out-of-plane thermal conductivity at room temperature. The AlN films (Orange triangles) were measured in this study, while the out-of-plane thermal conductivities of other AlN films were taken from literature.

	Density	Thickness
Thermal	5.08 g/cm^3	29.2 nm
ICP	5.62 g/cm^3	31.1 nm
-14 V	6.09 g/cm^3	31.3 nm
-24 V	6.11 g/cm^3	27.4 nm
-34 V	6.16 g/cm^3	28.5 nm

Table1. Summary of XRR Results. Film density quickly saturates after -14 V substrate bias, demonstrating that ion bombardment performed every deposition cycle heals surface defects and thus densifies the film. The variations in thickness are due to both film densification at moderate biases and the onset of sputtering at higher biases.