Flexible Alucone/Al_2O_3/Alucone hybrid dielectric layers using in-situ ALD/MLD techniques

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Flexible electronics have spread across an expansive area such as fundamental transistors, sensing devices, and flexible Organic light-emitting diode display. One of main issues for flexible electronics is mechanically robust insulator materials to work with flexible substrates and newly emerging semiconductor materials. Most of dielectric materials are based on inorganic materials such as oxide and nitrdie due to its high capacitance, low leakage and high breakdown field property. However, most of inorganic materials are limited for flexible electronic devices because inorganic materials showed brittleness characteristics with mechanical stress. In order to overcome this problem, inorganic/organic hybrid dielectric layers are suggested owing to the its superial mechanical property. However, it is challenging to make uniform pinhole free organic dielectric layer because there is no suitable process and materials. Molecular Layer Deposition (MLD) process might be strong cadidate for uniform phinhole free organic thin film deposition because MLD process can allow accurate thickness control and conformal coverage over the substrate area, accompanied by high film quality at low temperature.

In this study, we investigated dielectric properties of single alucone organic layer using MLD technique, and Al_2O_3/Alucone/Al_2O_3 inorganic/organic/inorganic structure using in-situ ALD/MLD process. As a result, the uniform and well aligned inorganic/organic/inorganic structure was fabricated as shown in figure, and suggested hybrid layer exhibited excellent dielectric properties. This presentation will be discussed with I-V, C-V characteristics of single alucone and Al_2O_3/Alucone/Al_2O_3 thin films with time after fabrication, and bending stress. Also, FIB, FT-IR, XPS, AES depth profile results and electrical Ca-test measurement will be discussed in order to investigate more detail film properties.

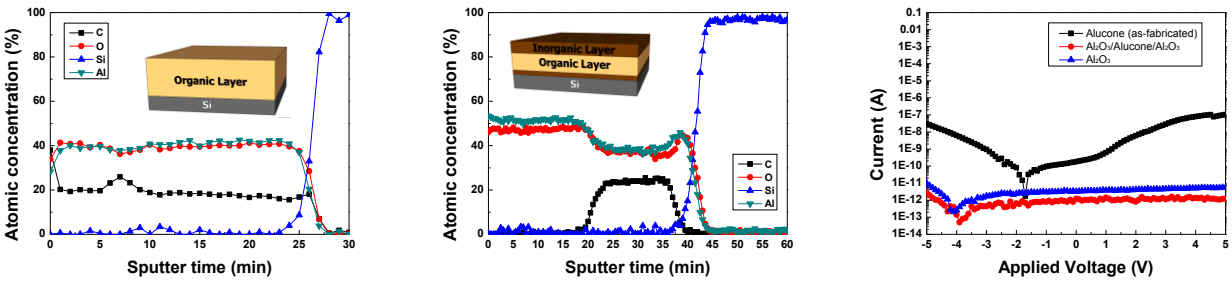

Fig. 1. AES depth profile of Alucone thin films (left) and Al_2O_3/Alucone/Al_2O_3 multi stack thin films (center) on Si substrates. Representative I-V curve of Alucone, Al_2O_3 and multi stack thin films