

## Supporting Information

### Synthesis of ion conducting $\text{Li}_x\text{Al}_y\text{Si}_z\text{O}$ thin films by atomic layer deposition

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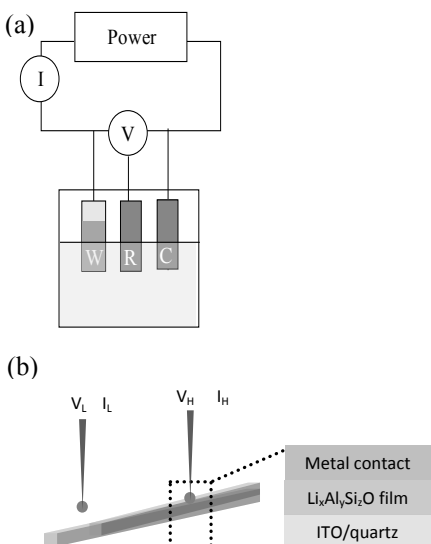
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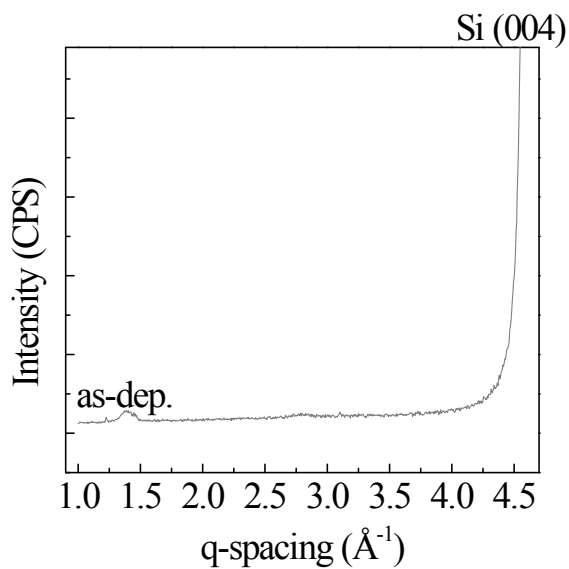
## Figure S1

Experimental arrangements for electrochemical measurements: (a) cyclic voltammetry (CV) of a ferrocene solution was used to establish whether pinholes were present in the deposited LASO film. The working electrode (W) is LASO-coated ITO; (b) experimental arrangement for impedance measurements.



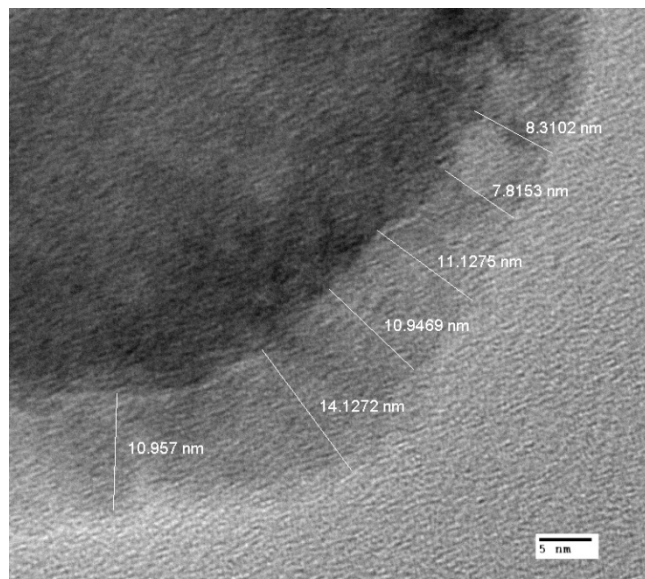
**Figure S2**

Synchrotron X-ray diffraction pattern of as-deposited LASO film (10 nm thick) grown on Si(100) substrate using the 10(Al-O)-6(Li-O)-4(Si-O) sequence. The as-deposited  $\text{Li}_x\text{Al}_y\text{Si}_z\text{O}$  sample did not show any diffraction peak when aligned to the substrate peak of Si(004) at  $q=4.62 \text{ \AA}^{-1}$  (JCPDS no. 00-001-0787) ( $q$  is defined as  $2\pi/d$  where  $d$  is the interplanar spacing in  $\text{\AA}$ ). Experiments were performed at beamline 7-2 of the Stanford Synchrotron Radiation Lightsource (SSRL).



### Figure S3

High Resolution Transmission Electron Microscopy (HRTEM) image of a  $\text{Li}_x\text{Al}_y\text{Si}_z\text{O}$  thin film deposited on 45nm Au/SiO<sub>2</sub> core-shell nanoparticle. This image provides for better contrast to ascertain the film thickness. As-deposited  $\text{Li}_x\text{Al}_y\text{Si}_z\text{O}$  thin films were found to have a conformal coating of 8-14nm (grey) on the Au/SiO<sub>2</sub> nanoparticle (black). FEI Tecnai HRTEM with acceleration voltage of 300 kV was used to take the image.



**Table S1**List of experimental conditions used for the deposition of  $\text{Li}_x\text{Al}_y\text{Si}_z\text{O}$ .

Materials	Metal-organic precursors	Housing temp. (°C)	Gasline temp. (°C)	Pulse times (s):			
				Precursor	Pump	Water	Pump
LiOH	LTB	160	160	10	50	10	50
Al <sub>2</sub> O <sub>3</sub>	TMA	RT	60	5	45	5	45
SiO <sub>2</sub>	TEOS	RT	60	10	50	10	50