Influence of sputtering ion-beam current on the structure and ionic conductivity of LiPON solid-state electrolyte films
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Ionic conducting thin film amorphous electrolytes are promising candidates for microelectronics applications. This study presents an investigation into the structure and composition of lithium phosphorus oxynitride (LiPON) thin film electrolyte prepared by ion beam assisted deposition (IBAD) system sputtering on Li3PO4 target. X-ray photoelectron spectra (XPS) were used to determine the structure and composition of LiPON thin films. Analysis of nanoindentation indicated that the hardness and elastic modulus of LiPON solid-state electrolyte films varies with the beam current.

It was found that increasing beam current during the deposition process resulted in a greatly increased formation of triply coordinated —N< (Nt) as compared to doubly coordinated —N— (Nd) in LiPON thin films. The highest hardness of 5.8 GPa and the highest critical fracture load of 3.01 mN occurred at equal atomic percentage of nitrogen and phosphorus, i.e. N/P=1 at the beam current of 18 mA, when the ionic conductivity reaches a maximum. The higher hardness and lower stress are important parameters to prevent LiPON solid-state electrolyte films delamination from electrodes, which is crucial in evaluating the electrochemical performance of thin film lithium ion battery.