Electronic Supplementary Material (ESI) for Journal of Materials Chemistry A.

Electrochemical and Compositional Characterization of Solid Interphase Layers in an Interface-Modified Solid-State Li-Sulfur Battery

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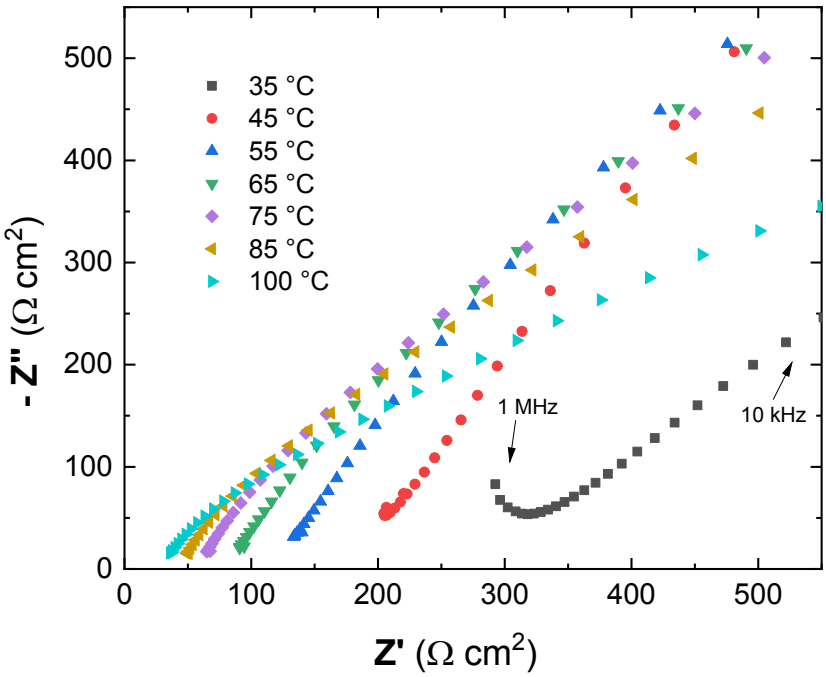

Figure S1: EIS plots at various temperatures for the Au|LLZO|Au cells.

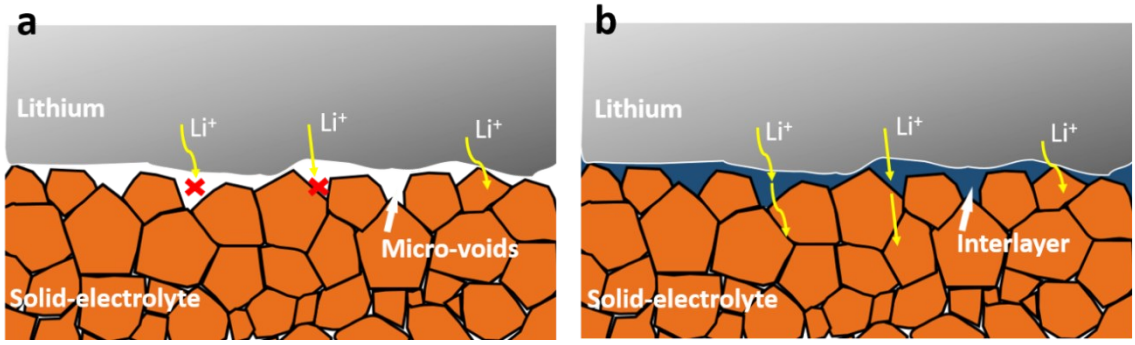

Figure S2: Schematic illustration of the interlayer enhancing the interfacial properties. The IL based interlayers can efficiently fill the micro-voids at the electrode|SE interface, thus improving the Li^+ transport and regulating the Li^+ flux.

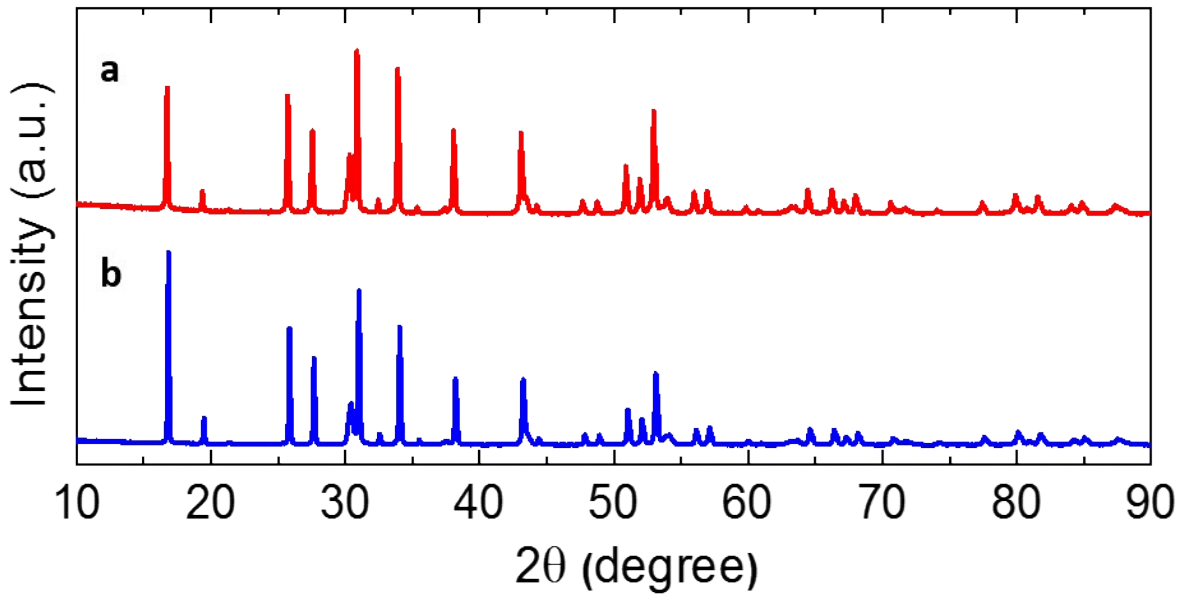

Figure S3: XRD patterns of the LLZO SE a) after one-week exposure to the IL based gel/solution, b) before exposure.

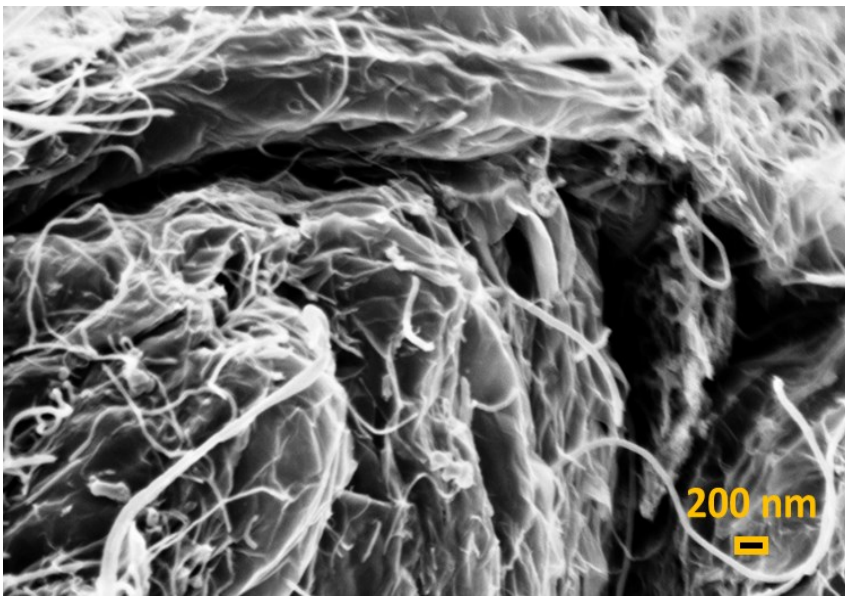

Figure S4: SEM images of the S/NC cathode material

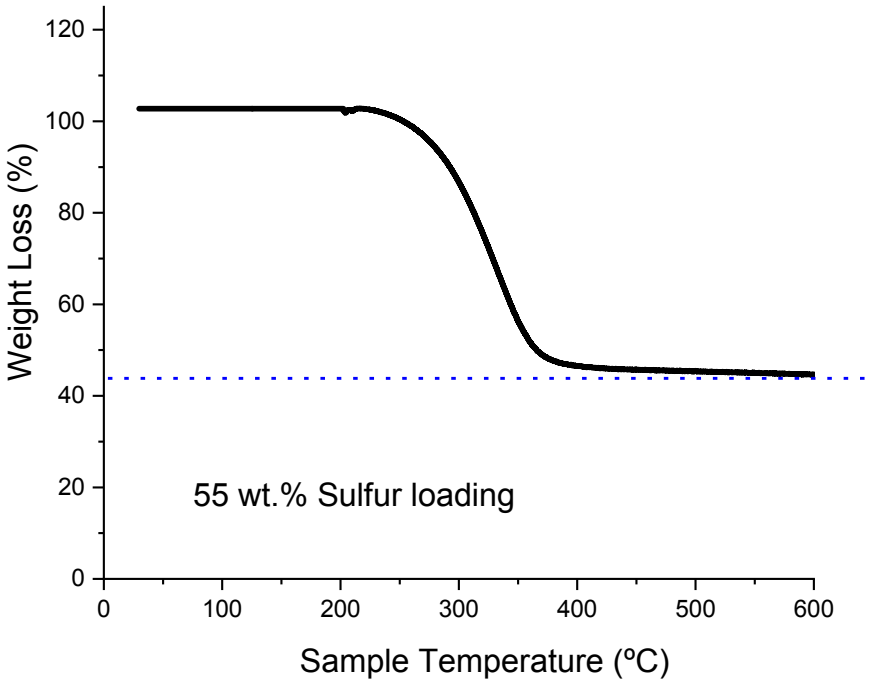

Figure S5: TGA curve of the S/NC cathode

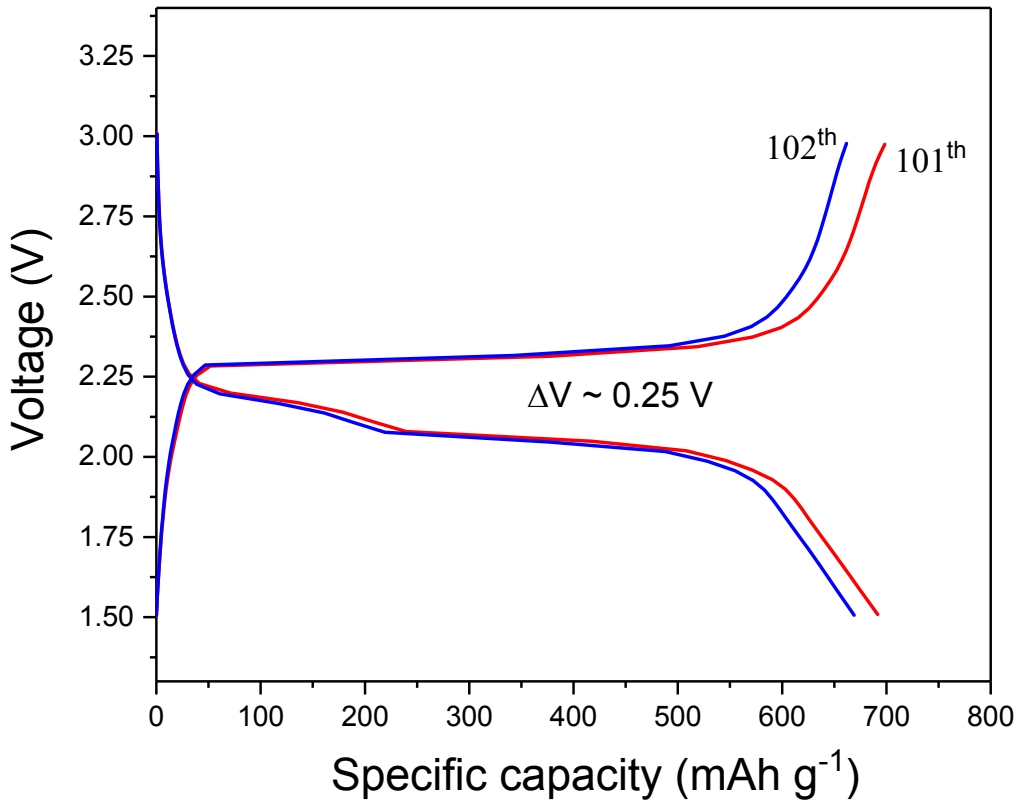

Figure S6: Galvanostatic charge/discharge voltage profiles for Li/S solid-state cell at 50 °C.

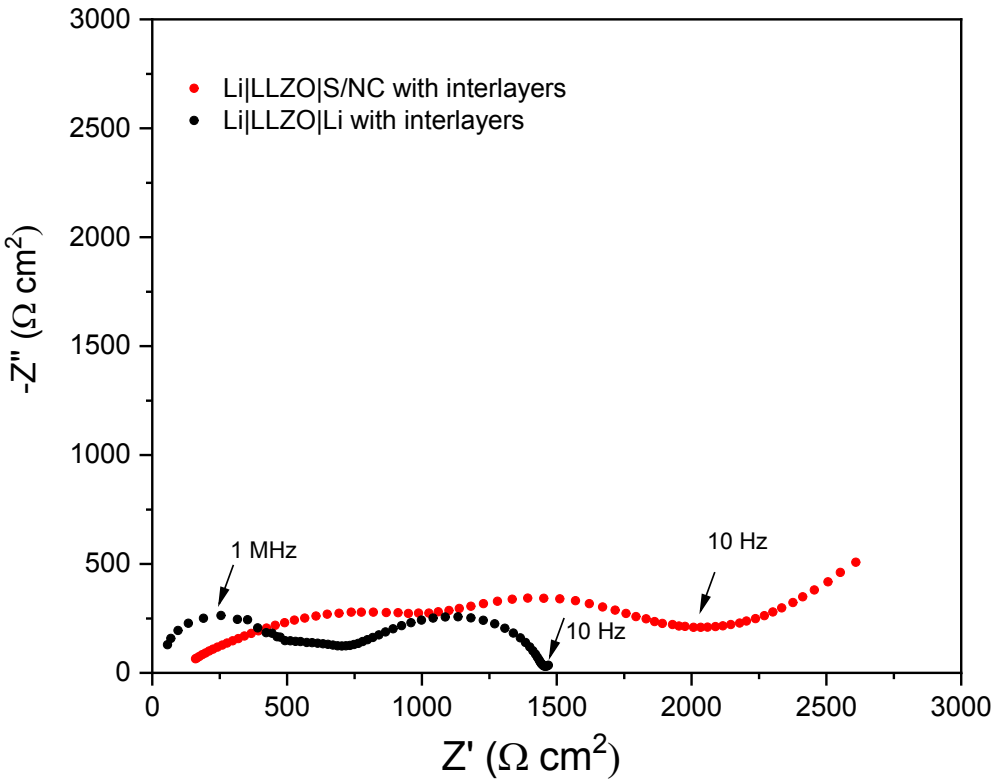

Figure S7: Comparison of the impedance spectra between Li|LLZO|S/NC full cell and Li|LLZO|Li symmetrical cells with interlayers.

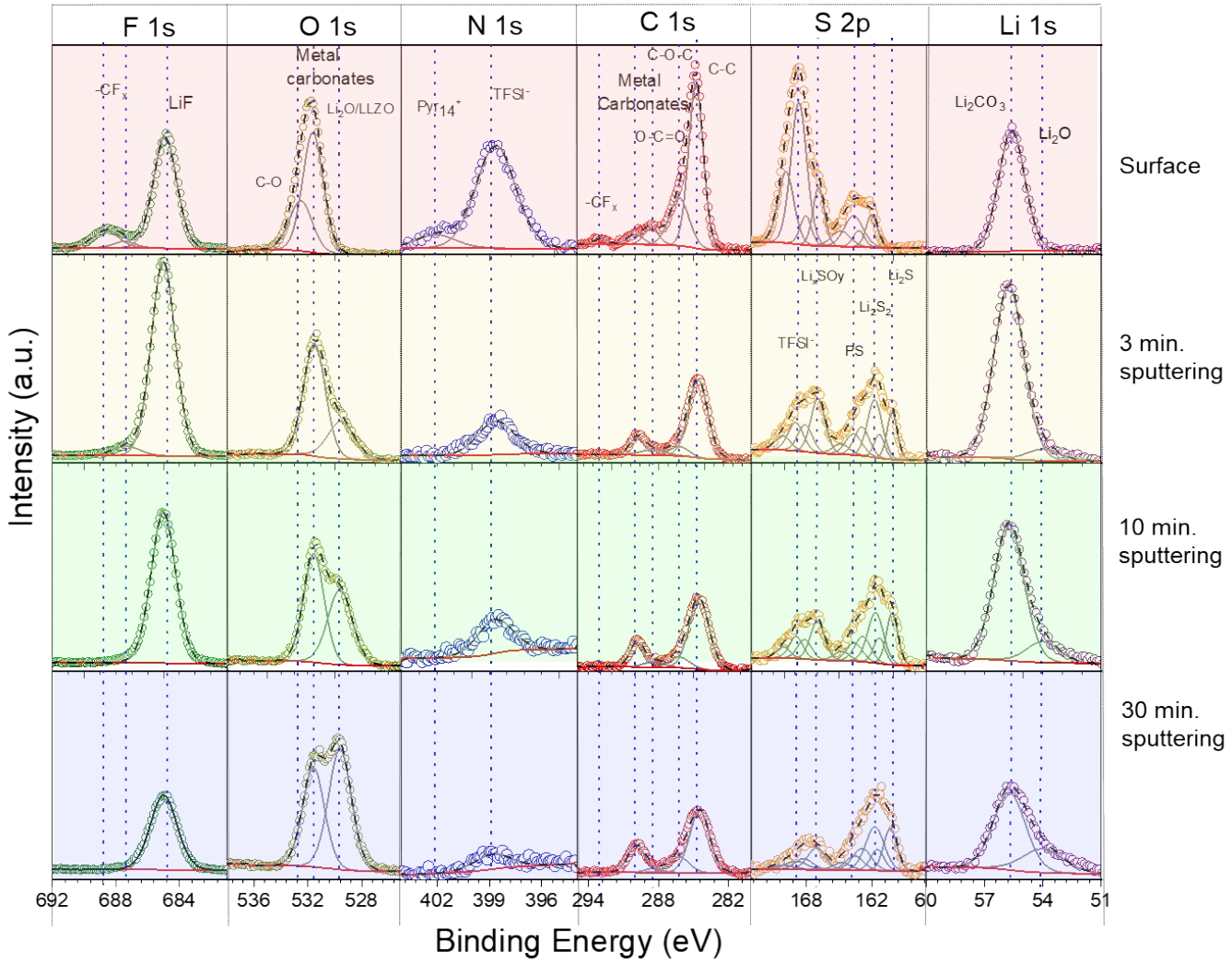

Figure S8: XPS detail spectra of different binding energy regions characteristic for various chemical elements present in the interphase layer at the S/NC|LLZO interface. The spectra were recorded on the original interphase surface and after 3, 10 and 30 minutes of Ar^+ sputtering.

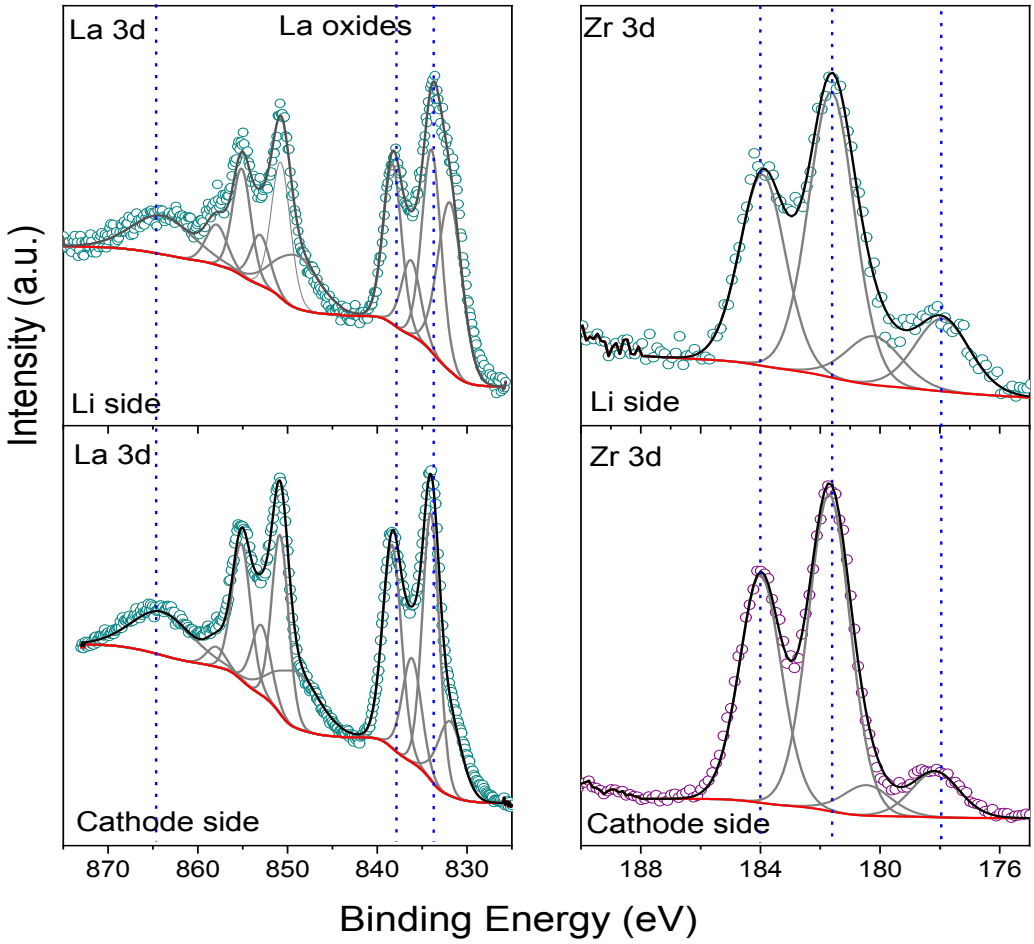

Figure S9: XPS detail spectra of different binding energy regions characteristic for La and Zr present at the Li and the cathode interfaces. Spectra recorded after 30 of Ar sputtering. No spectra for the La and Zr were obtained on the original interphase surface, after 3, and 10 minutes Ar^+ sputtering.

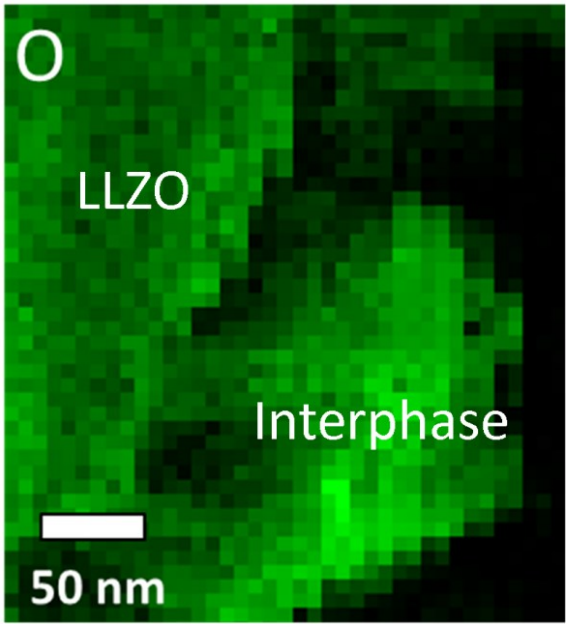

Figure S10: STEM-EDS spectrum imaging shows oxygen distribution in the LLZO and interphase layer.

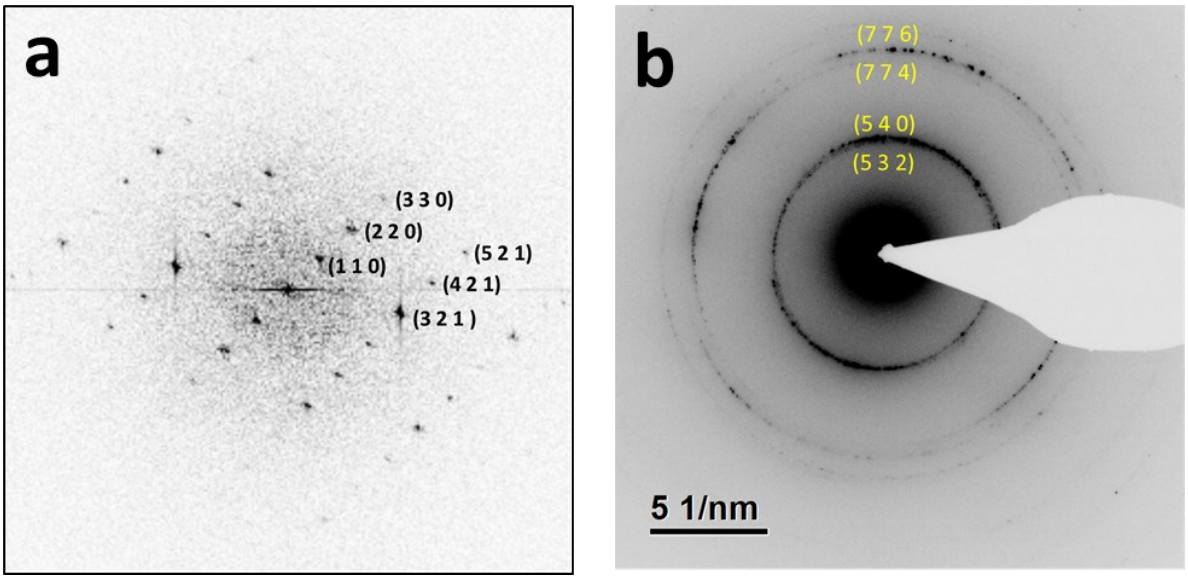

Figure S11: Fast Fourier transform (FFT) and the selected are electron diffraction (SAED) patterns of cubic phase LLZO.

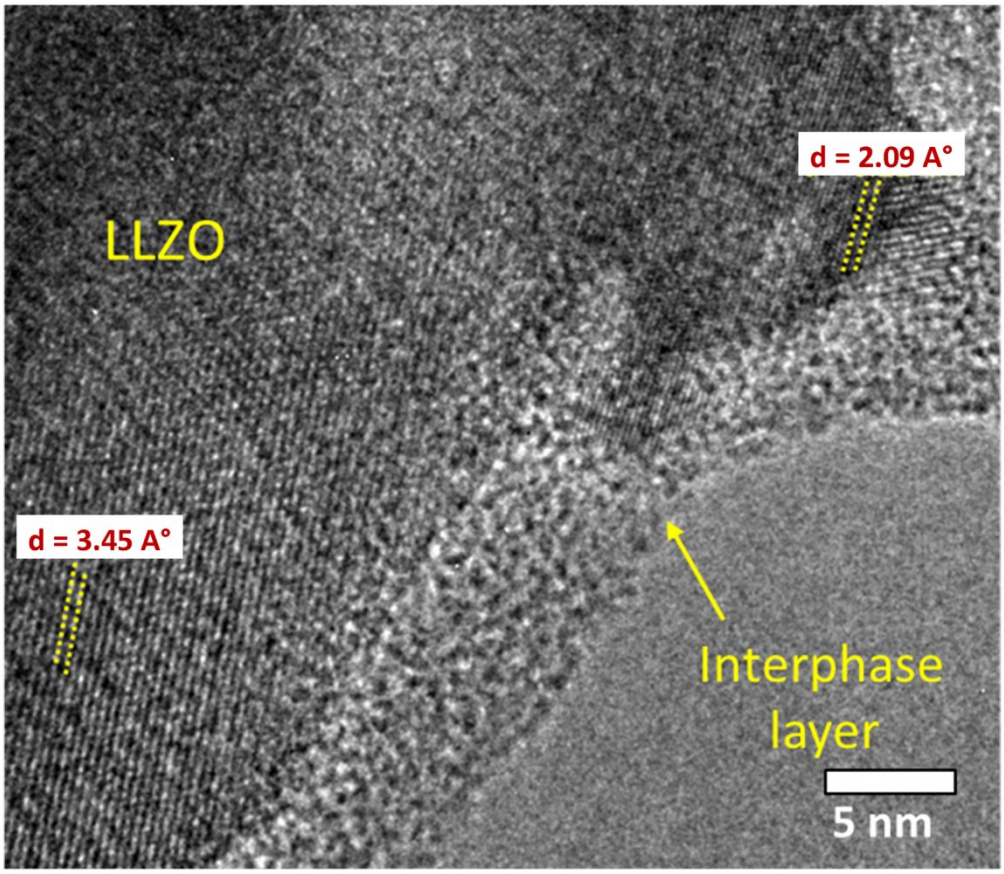

Figure S12: HRTREM image of the LLZO particle revealing different lattice fringes (d =3.45 A^{o}, 2.09 A^{o}) for the polycrystalline LLZO materials and the presence of interphase layer.