Supplementary Information

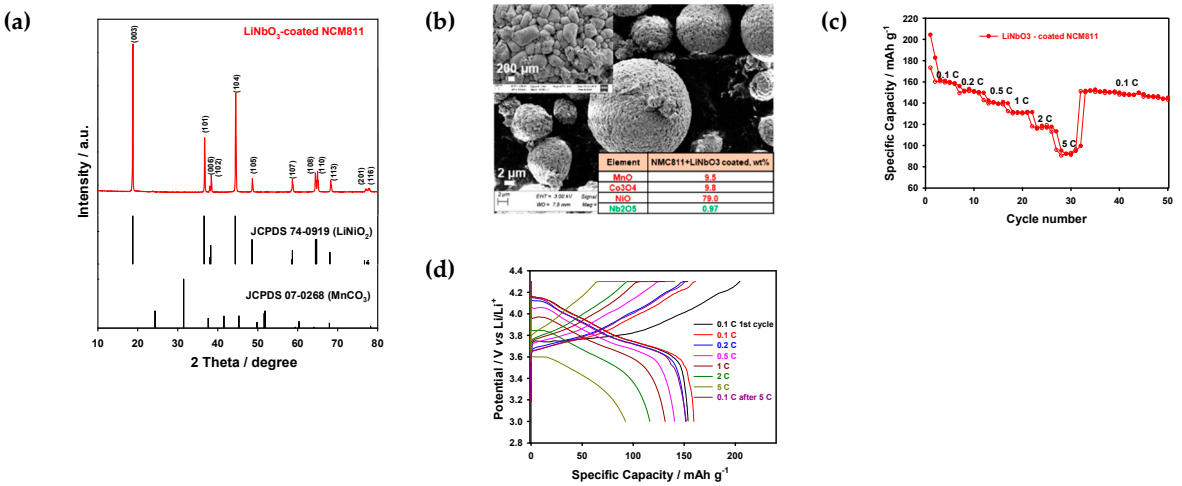

Figure S1. (a) XRD pattern and (b) SEM and XRF of the NCM811 coated via $LiNbO_3$ powder. (c) Rate capabilities and (d) voltage curves of the NCM811 coated $LiNbO_3$ electrode tested in the liquid electrolyte of 1 M $LiPF_6$ in EC DEC (1:1 v/v) in the potential range of 3.0–4.3 V (vs. Li/Li^+) at various current densities at room temperature.

The NCM cathodes were prepared by blending the obtained powder ($LiNi_{0.8}Co_{0.1}Mn_{0.1}O_2$ coated by $LiNbO_3$ 1 wt%, NEI corp) (92 wt%), polyvinylidene fluoride (Sigma-Aldrich) binder (4 wt%), and carbon black (Super C65, Imerys) conductor (4 wt%) in N-methyl pyrrolidone (NMP, Sigma-Aldrich) via an automatic mixing machine (THINKY MIXER, ARE-250) to obtain a uniformly mixed slurry and cast onto aluminum foil and dried at 120°C for 10 min to eliminate the NMP solvent; the electrode sheets were pressed to ensure interparticle contact and reduce the porosity of the electrode, and then dried at 120°C for overnight in a vacuum oven. The active material of NCM cathodes as a working electrode, Li-metal foil as a counter electrode, and polypropylene as the separator (Celgard 2500) were chosen as the conventional liquid electrolyte of 1 M $LiPF_6$ in EC DEC 1/1 v/v (Aldrich). The charge–discharge tests of NCM cathodes/Li cells were conducted using CR2016 coin-type cells fabricated in an argon-filled glove box. The electrochemical tests were performed at room temperature. The cycling performance was investigated by a MACCOR tester battery cycler in a potential range of 3.0–4.3 V at different C-rates (0.05 C, 0.1 C, 0.2 C, and 0.5 C) applied to cells to evaluate C-rate performance.

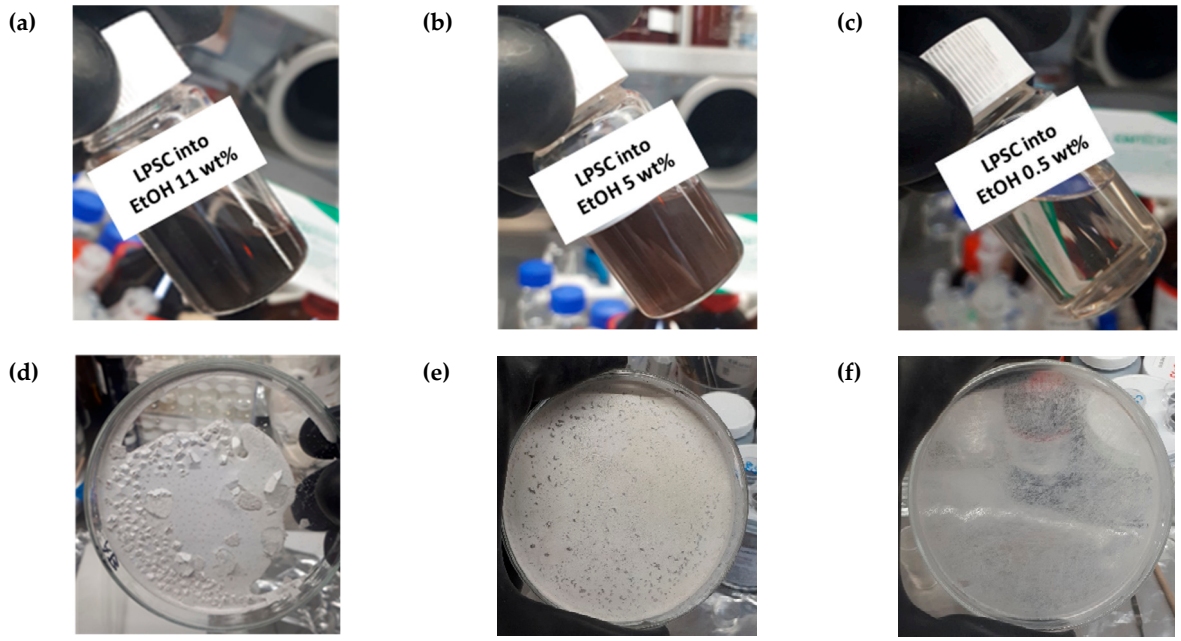

Figure S2. Solution of solid electrolyte of Li_6PS_5Cl into ethanol of (a) 11 wt%, (b) 5 wt%, (c) 0.5 wt%, and (b) solid electrolyte treated with ethanol and depicted after drying at 180°C for 2 h of (d) 11 wt%, (e) 5 wt%, and (f) 0.5 wt%.

Table S1. Solvent and solvent systems that have been used for the infiltration route of NCM cathode materials and selected properties (solvents were used in the given reference for preparation of sulfide-electrolyte solutions.

Solvent	**Classification**	**T_{bp}, °C**	**Density, g cm^{-3}**	**Vapour pressure, hPa**	**Dielectric constant**	**Hazards**	**Reference**
Anisole	aprotic, polar	155	1.00	4.7 (25°C)	4.3	nontoxic	1, 2, 3
Ethyl acetate	aprotic, polar	77	0.902	97.32	6.02	toxic	1, 2, 3
Ethanol	protic, polar	78	0.789	44.6	24.5	toxic	1, 2, 3
Ethanol + Anisole							
Ethanol + Ethyl acetate							

Reference:

[1] Dielectric Constant of Common solvents.xls (washington.edu)

[2] Dielectric Constant Table.pdf (honeywellprocess.com)

[3] Physicochemical properties of solvents (SigmaAldrich.com)

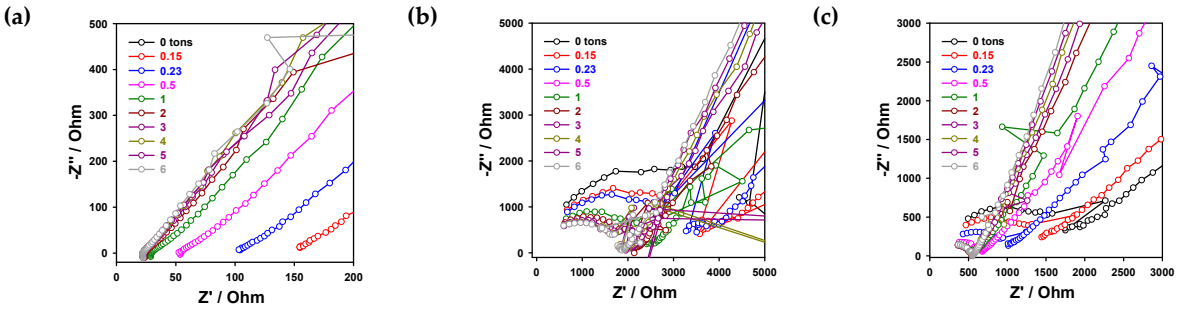

Figure S3. Nyquist plots of the (a) pristine used for EIS measurements of Li_6PS_5Cl samples as well as after treatment with ethanol and subsequent drying at (b) 80°C and (c) 180°C.

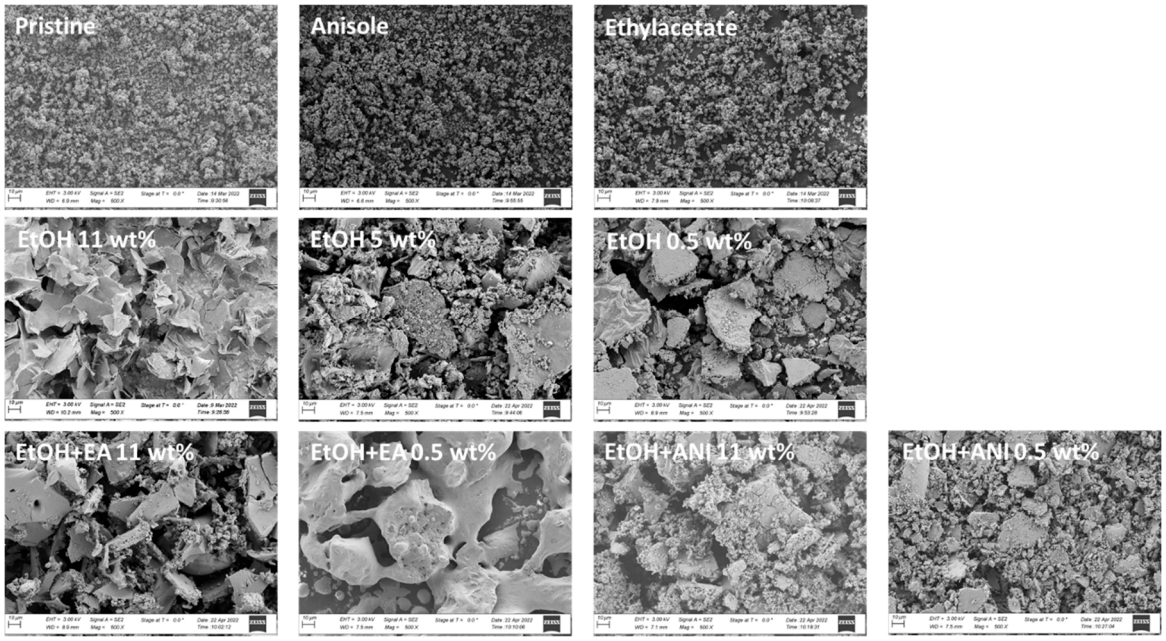

Figure S4. SEM images of solid electrolyte treated with different solvents and depicted after drying at 180°C for 2 h.

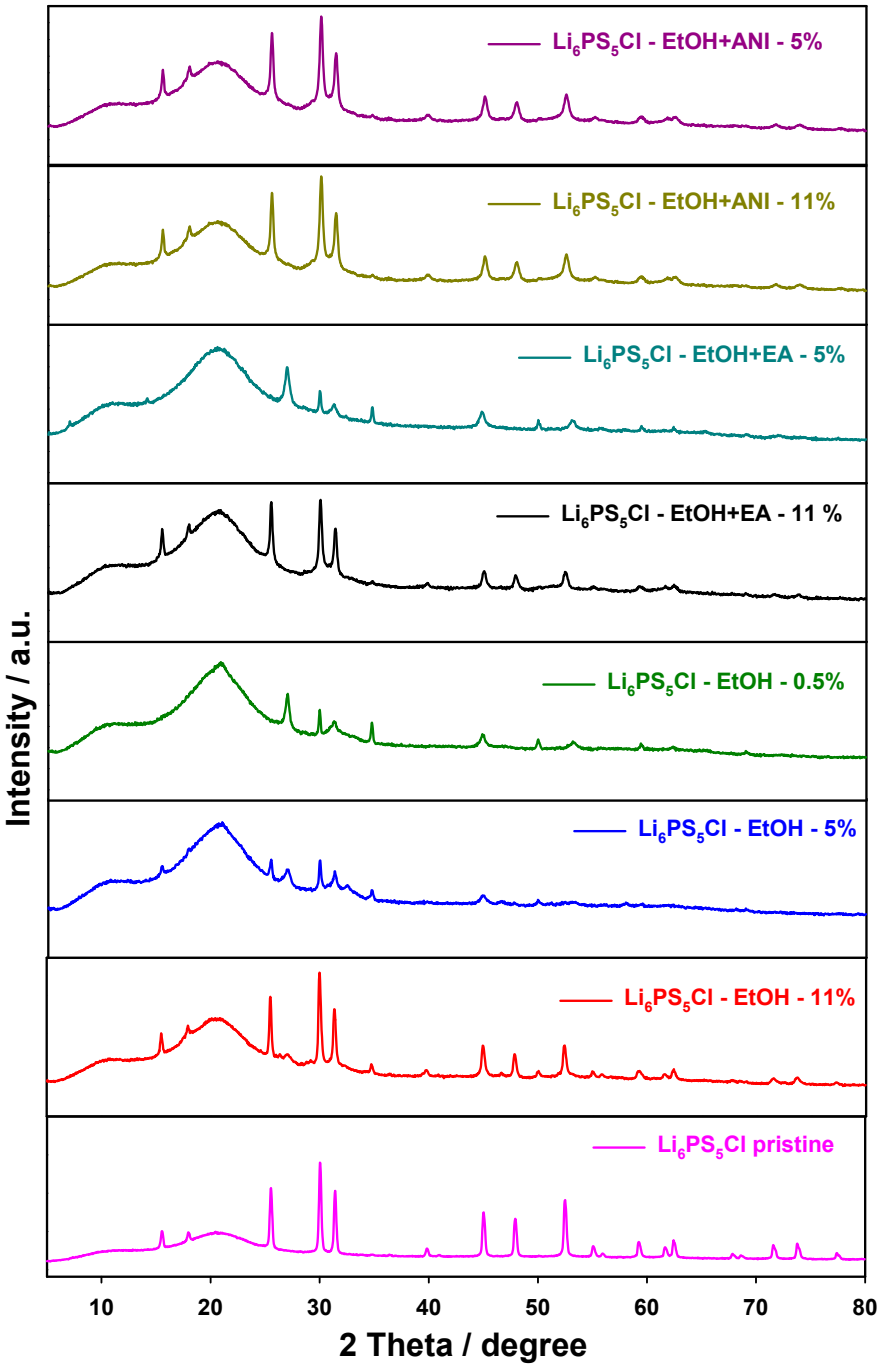

Figure S5. XRD patterns of solid electrolyte treated with different solvents and depicted after drying at 180°C for 2 h.

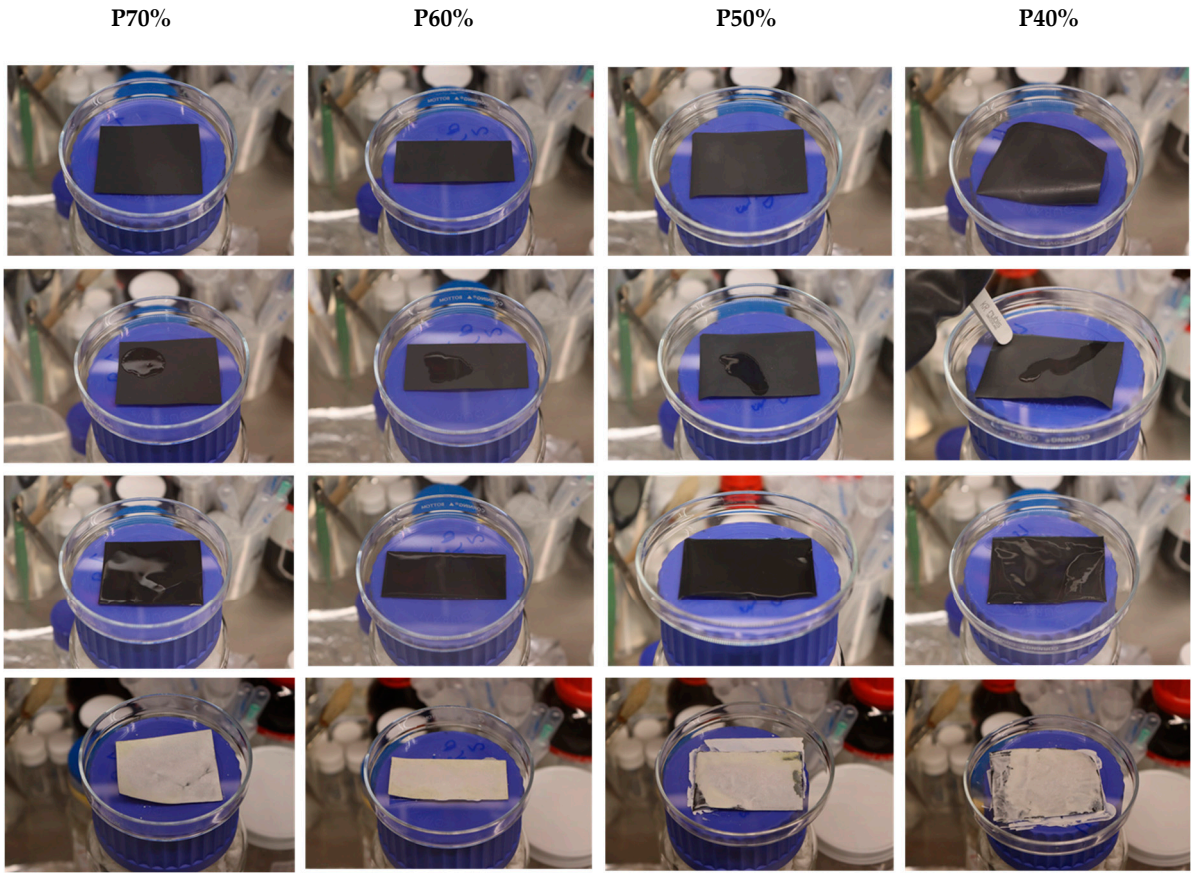

Figure S6. The NCM811 electrode materials with immersed solid electrolyte and their compatibility via ethanol solution indicated by wettability.

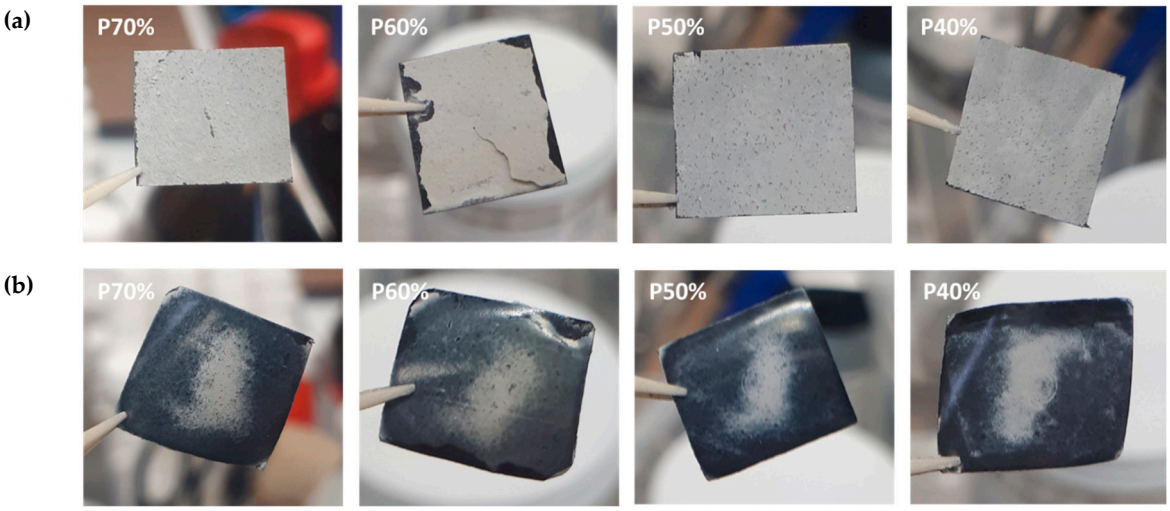

Figure S7. The NCM811 electrode materials with immersed solid electrolyte (a) before and (b) after densification.