Electronic Supplementary Material (ESI) for Physical Chemistry Chemical Physics.

Table I. Summary of apparent k^* and D^* derived from SIMS profile fitting.

Sample	YSZ orientation	GDC condition	Exchange T °C	k^* cm/s	D^* cm^2/s
A	(100)	Annealed	600	0.66×10^{-6}	0.28×10^{-8}
B	(100)	As-grown	600	1.34×10^{-6}	0.45×10^{-8}
C	(111)	As-grown	600	7.33×10^{-6}	6.08×10^{-8}
Bulk	-	-	600	0.083×10^{-6}	0.013×10^{-8}

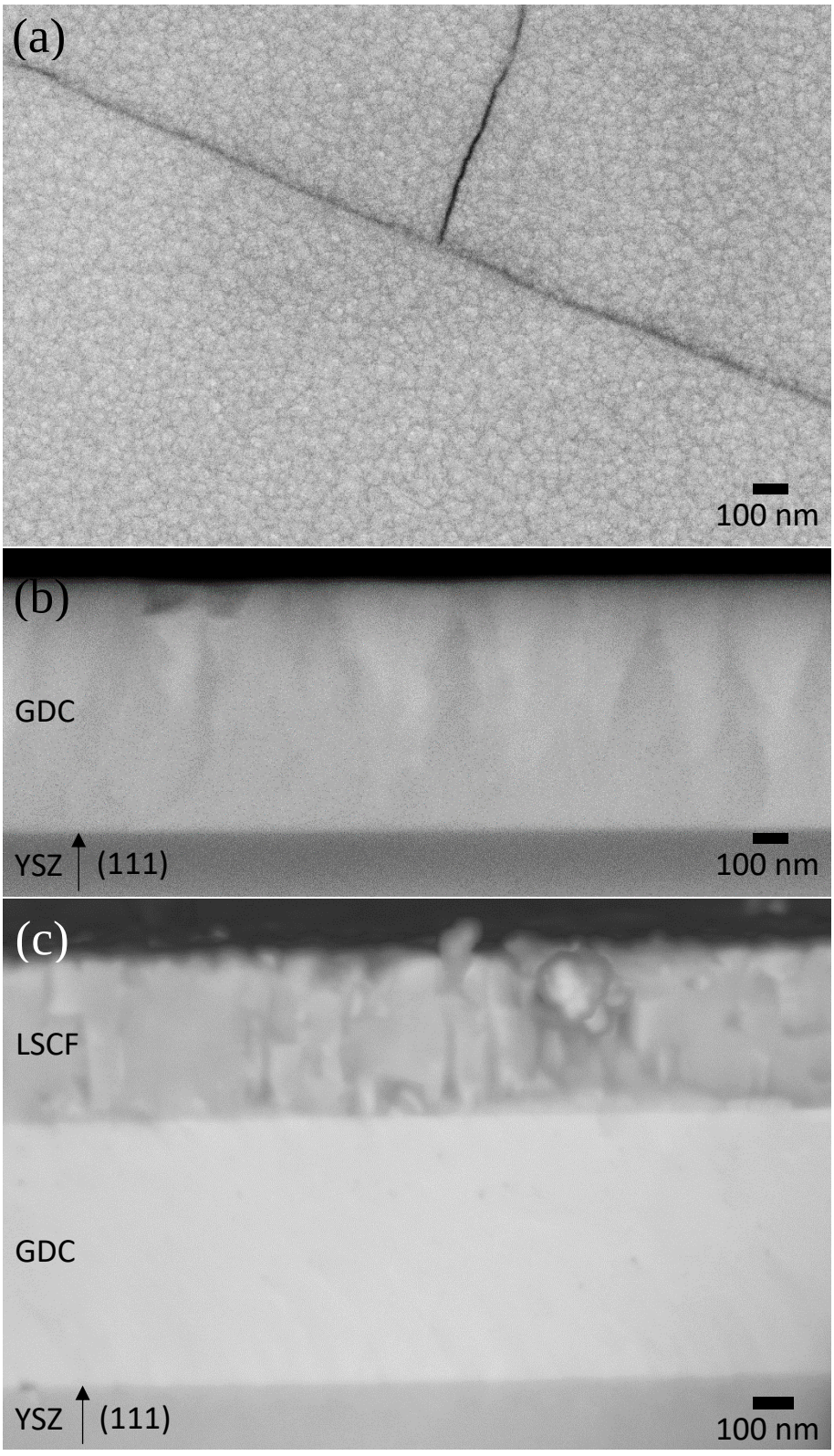

Fig. S1. Typical SEM images of as-grown GDC on (111) YSZ depicting the (a) surface morphology and (b) cross-section. Densification of the GDC layer after the deposition of the

LSCF layer is evident in the cross-sectional SEM image of Sample C (before long-term annealing) shown in (c).

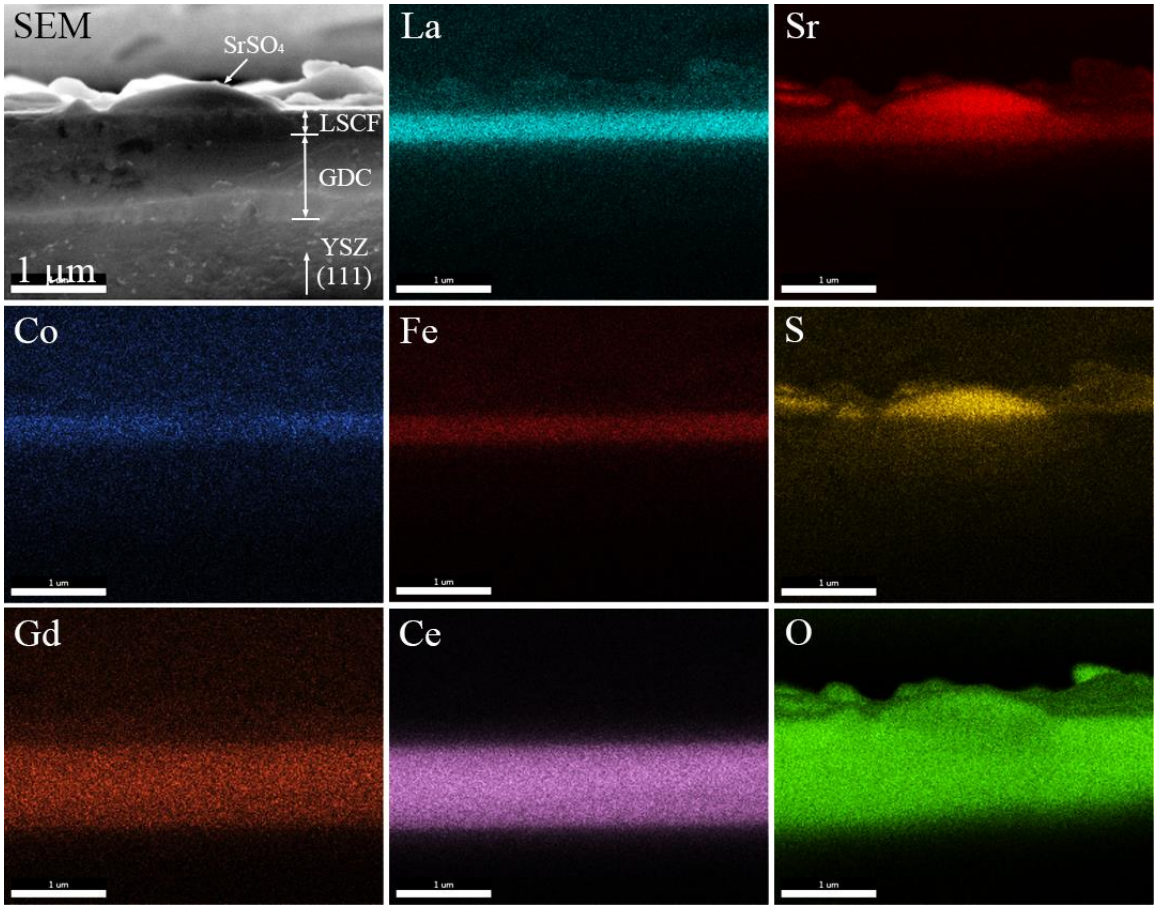

Fig. S2. Typical SEM-EDX elemental mapping results for a LSCF/as-grown GDC/(111) YSZ (Sample C) after annealing at 800 °C/1 month, revealing surface crystallites containing both Sr and S, which indicate $SrSO_4$ formation.

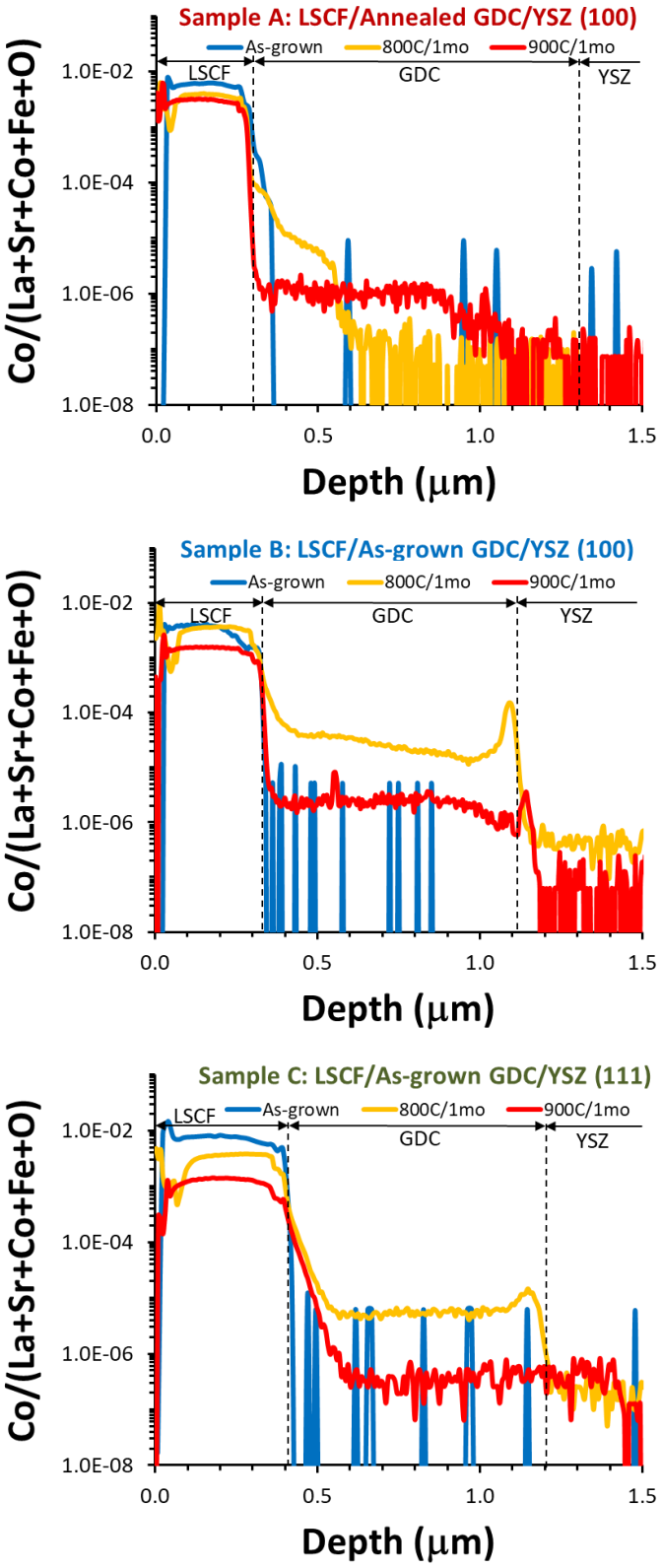

Fig. S3. Comparison of Co signals normalized by the total of secondary ion intensities as extracted from SIMS depth profile intensities for Samples A, B, and C, showing the as-grown as well as annealed samples.

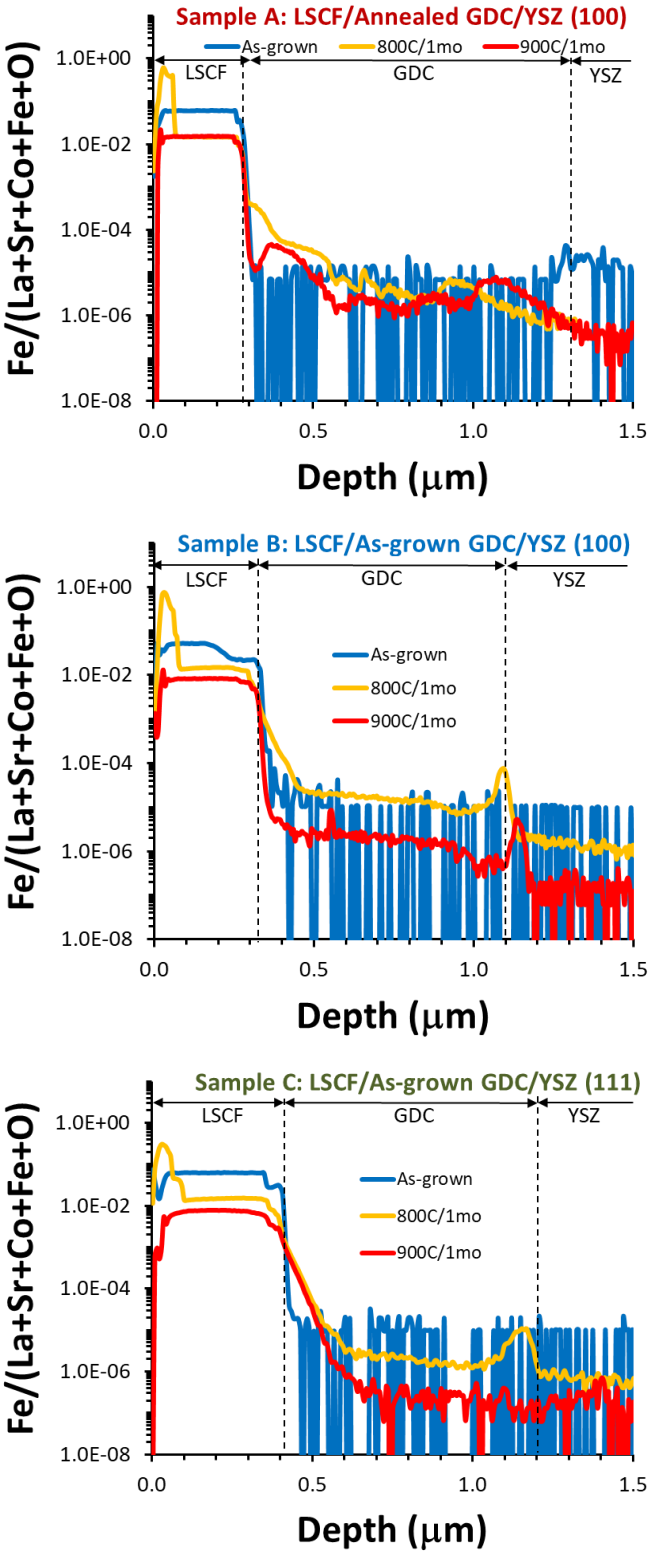

Fig. S4. Comparison of Fe signals normalized by the total of secondary ion intensities as extracted from SIMS depth profile intensities for Samples A, B, and C, showing the as-grown as well as annealed samples.