Supplementary information

Recent advances in layered $Ln_2NiO_{4+\delta}$ nickelates: fundamentals and prospects for their applications in protonic ceramic fuel and electrolysis cells

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Figures: 5

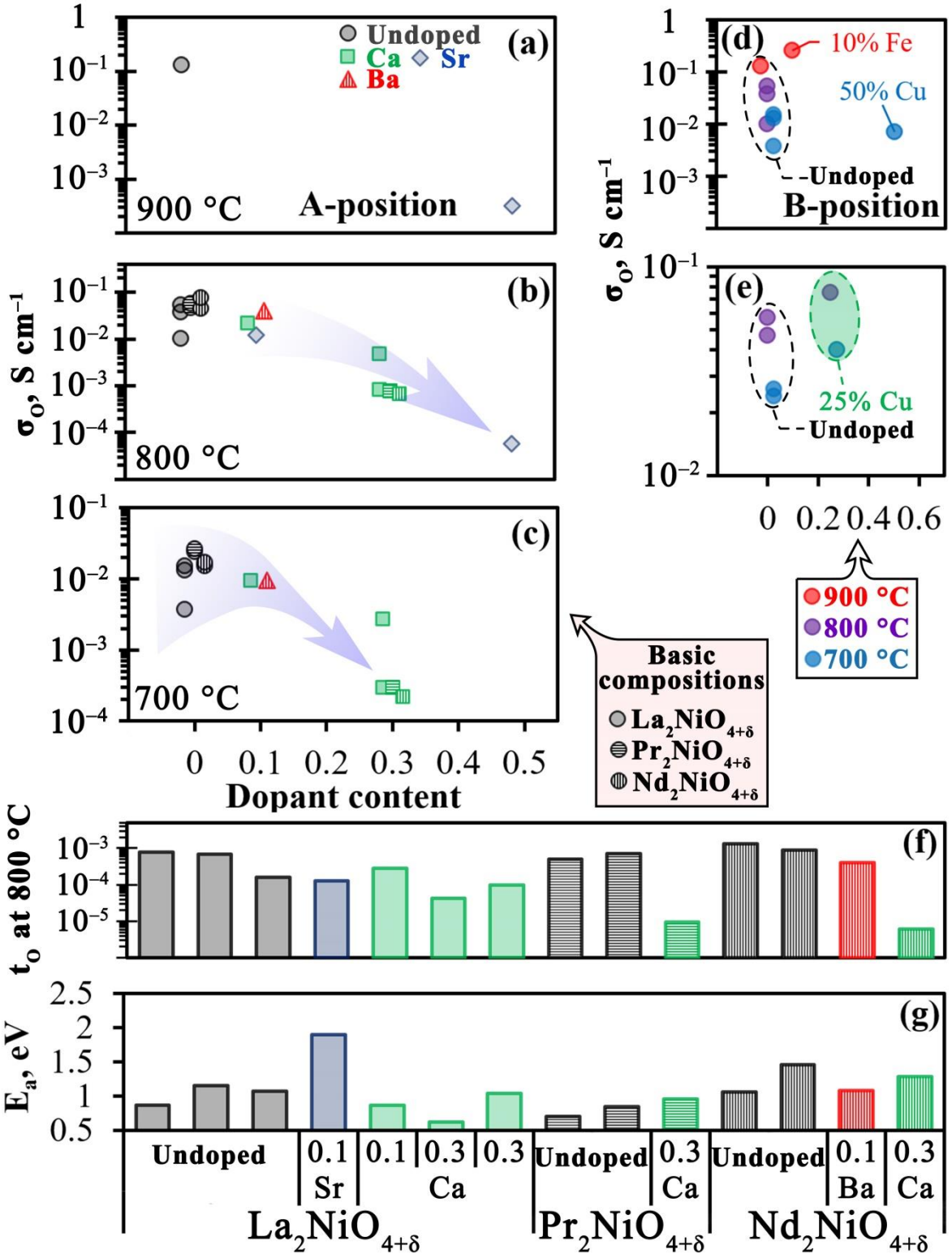

Figure S1. Relationships between compositions of nickelate materials with their oxygen-ionic transport features: oxygen-ionic conductivity of the A-site doped nickelates measured at 900 °C (a), 800 °C (b) and 700 °C (c); oxygen-ionic conductivity of the B-site doped lanthanum nickelates (d) and praseodymium nickelates (e); ionic transference number (f) and activation energy values (y) of ionic-conductivity for the basic and doped nickeltaes. These data were extracted from Table 2.

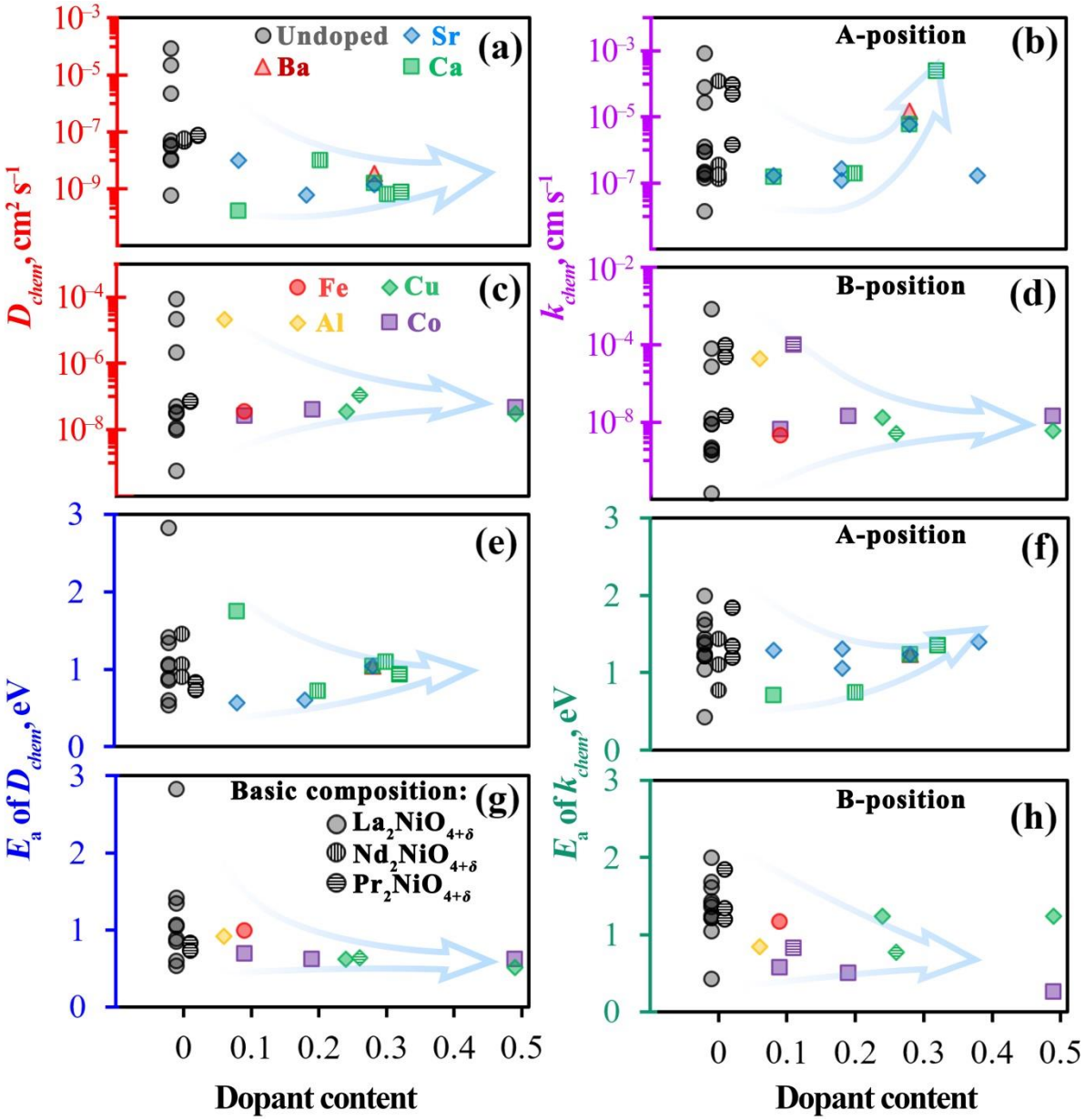

Figure S2. Oxygen surface exchange and diffusion coefficient values as well as the corresponding apparent activation energies for $Ln_2NiO_{4+\delta}$-based compounds. These data were presented on the basis of Table 3.

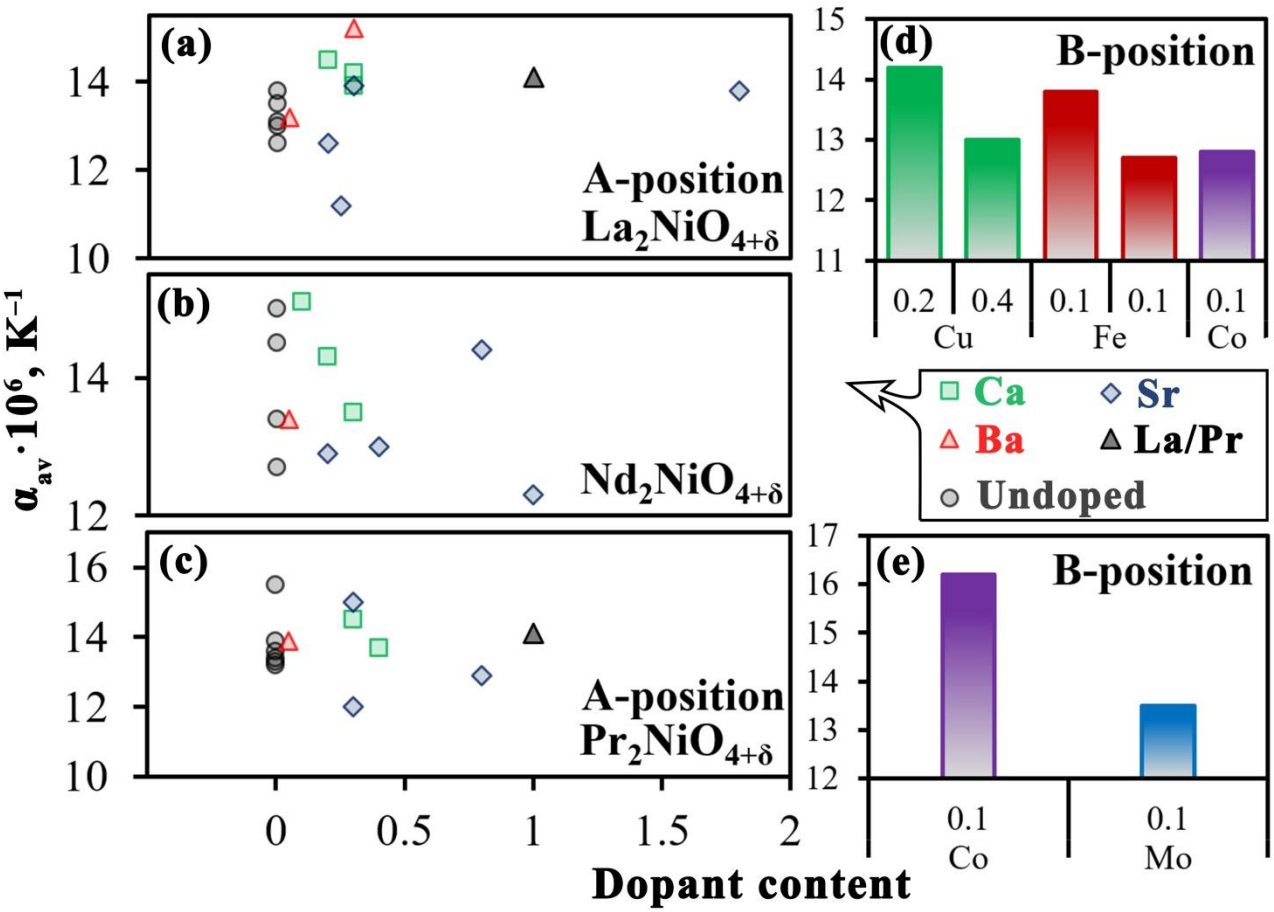

Figure S3. Concentration dependences of average thermal expansion coefficients for some undoped and A-site doped $La_2NiO_{4+\delta}$ (a), $Nd_2NiO_{4+\delta}$ (b), $Pr_2NiO_{4+\delta}$ (c) as well as for B-site doped $La_2NiO_{4+\delta}$ (d) and $Nd_2NiO_{4+\delta}$ (e). These data were extracted from Table 5.

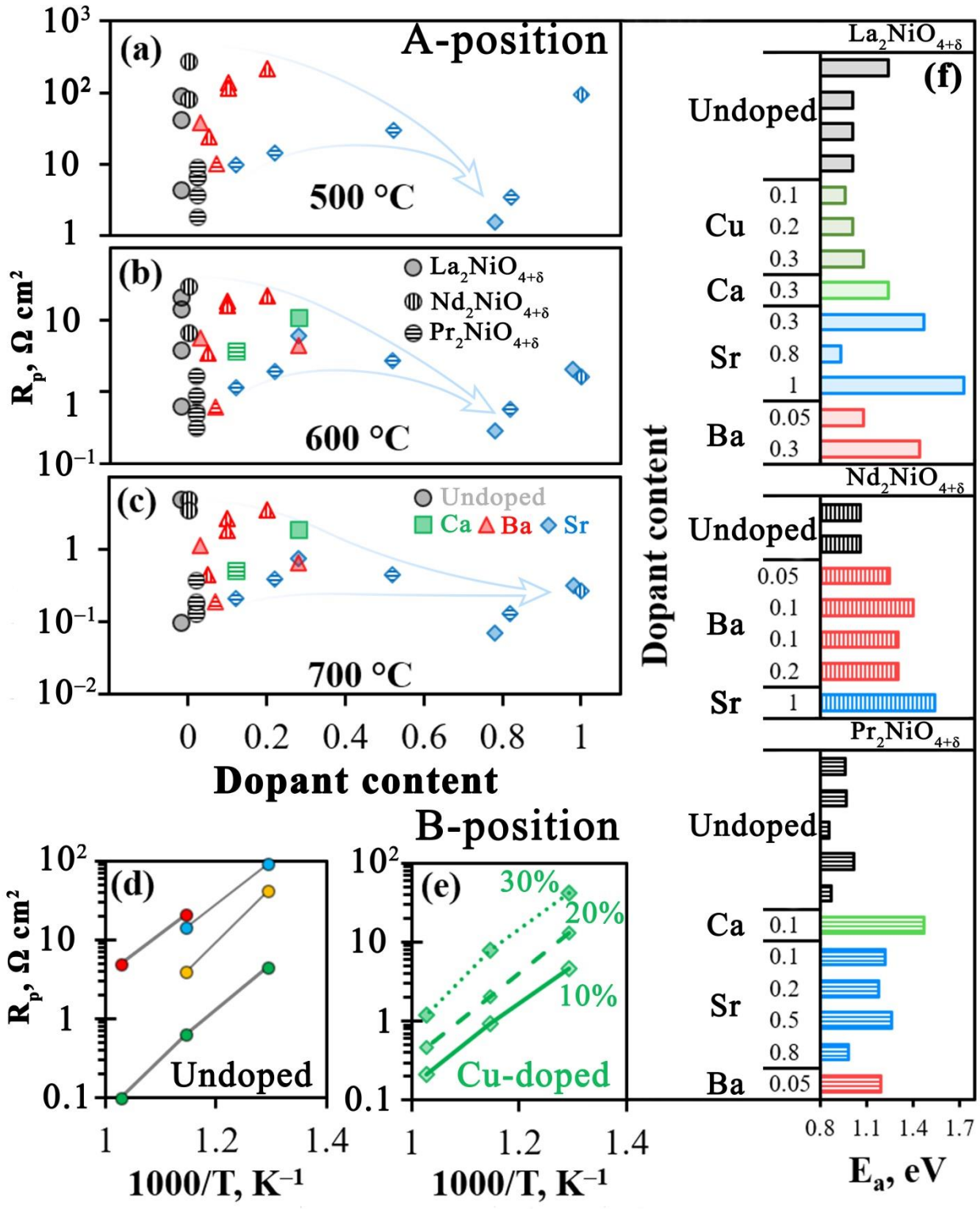

Figure S4. Electrochemical behavior of the nickelate electrodes measured for symmetrical cells: polarization resistances of the A-doped nickelates at 500 °C (a), 600 °C (b) and 700 °C (c); polarization resistances of the undoped $La_2NiO_{4+\delta}$ (d) Cu-doped $La_2NiO_{4+\delta}$ (e); activation energy values of the overall polarization conductivity. These data were presented on the basis of Table 4.

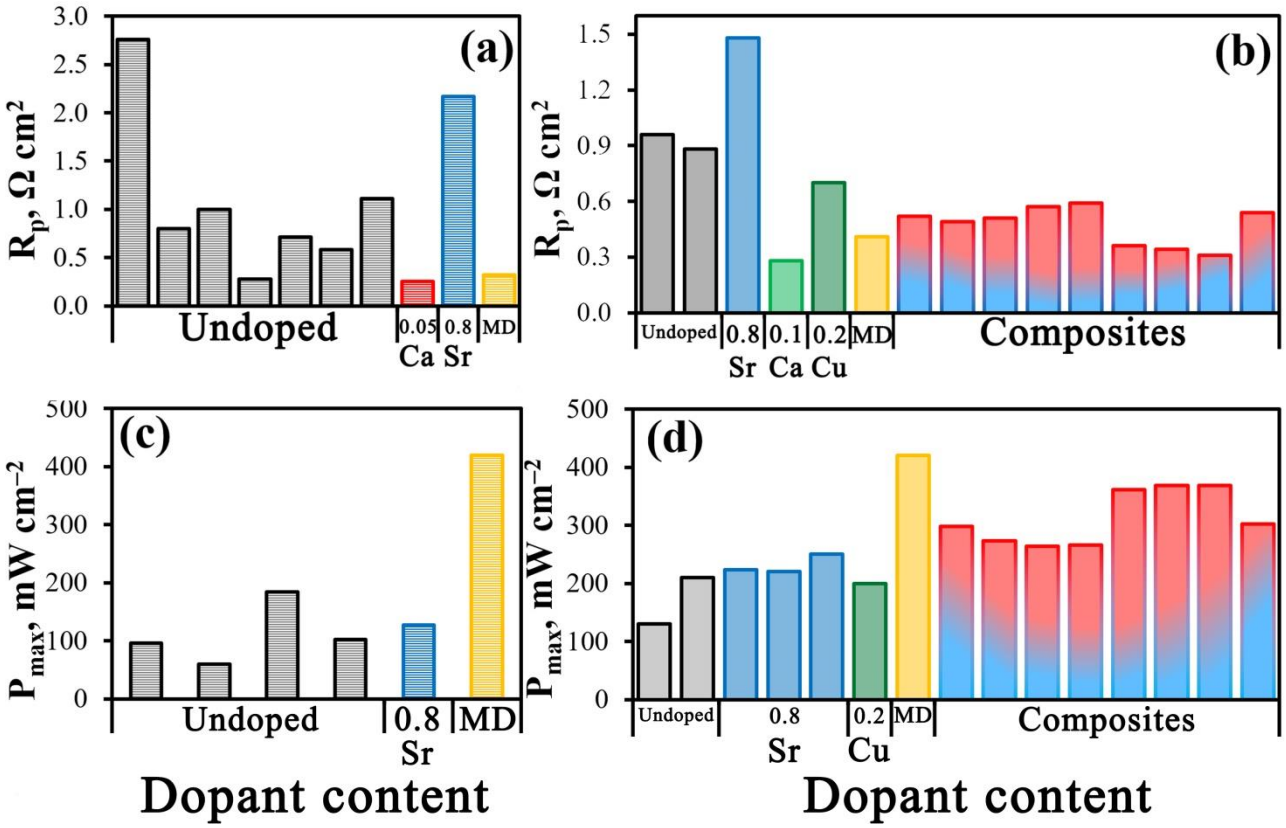

Figure S5. Performance of PCFCs with cathodes based on $Pr_2NiO_{4+\delta}$ (a,c) or $La_2NiO_{4+\delta}$ (b,d): polarisation resistances (a,b) and maximal power densities (c,d). These data were presented on the basis of Tables 9 and 10. MD is the multi-doped oxides. Composites are two-phase systems containing the undoped $La_2NiO_{4+\delta}$ component (weight ratios can be found in the corresponding tables).