Doping Homogeneity in Co-doped Materials Investigated at Different Length Scales

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Supporting information

1. EDX mappings
Figure S1: Electron micrographs detected via backscattered electrons (top left) and EDX mappings (top right and bottom) of La$_{0.94}$Nd$_{0.03}$Tm$_{0.03}$PO$_4$. The acceleration voltage is 30 kV.

Figure S2: Electron micrographs detected via backscattered electrons (top left) and EDX mappings (top right and bottom) of La$_{0.9}$Gd$_{0.05}$Dy$_{0.05}$PO$_4$. The acceleration voltage is 30 kV.
Figure S3: Electron micrographs detected via backscattered electrons (top left) and EDX mappings (top right and bottom) of La$_{0.92}$Nd$_{0.04}$Ho$_{0.04}$PO$_4$. The acceleration voltage is 30 kV.

2. NMR visibility maps

Figure S4: The NMR visibility map calculated from $^{31}$P MAS NMR data plotted against the substitution degree $x$ and $y$ in La$_{1-x-y}$Gd$_x$Dy$_y$PO$_4$ on a logarithmic scale. The dashed 3D plot (left) and its contour plot (right) feature the expected visibility function $f(x,y) = \exp[-a(r_{Gd}^3+x+r_{Dy}^3y)]$ with the values $a = 0.055/Å^3$, $r_{Gd} = 13.5$ Å and $r_{Dy} = 12.5$ Å being the same as for mono-doped LaPO$_4$. The contour levels were chosen according to the expected value for $f(x,y)$ at the point $(x,y)$. 
Figure S5: the NMR visibility map calculated from $^{31}$P MAS NMR data plotted against the substitution degree $x$ and $y$ in La$_{1-x-y}$Nd$_x$Tm$_y$PO$_4$ on a logarithmic scale. The dashed 3D plot (left) and its contour plot (right) feature the expected visibility function $f(x,y) = \exp[-a(r_{Nd}^3x+r_{Tm}^3y)]$ with $a = 0.055/Å^3$, $r_{Nd} = 5.5$ Å and $r_{Tm} = 9$ Å being the same as for monodoped LaPO$_4$. The contour levels were chosen according to the expected value for $f(x,y)$ at the point $(x,y)$. 