

Supplementary materials

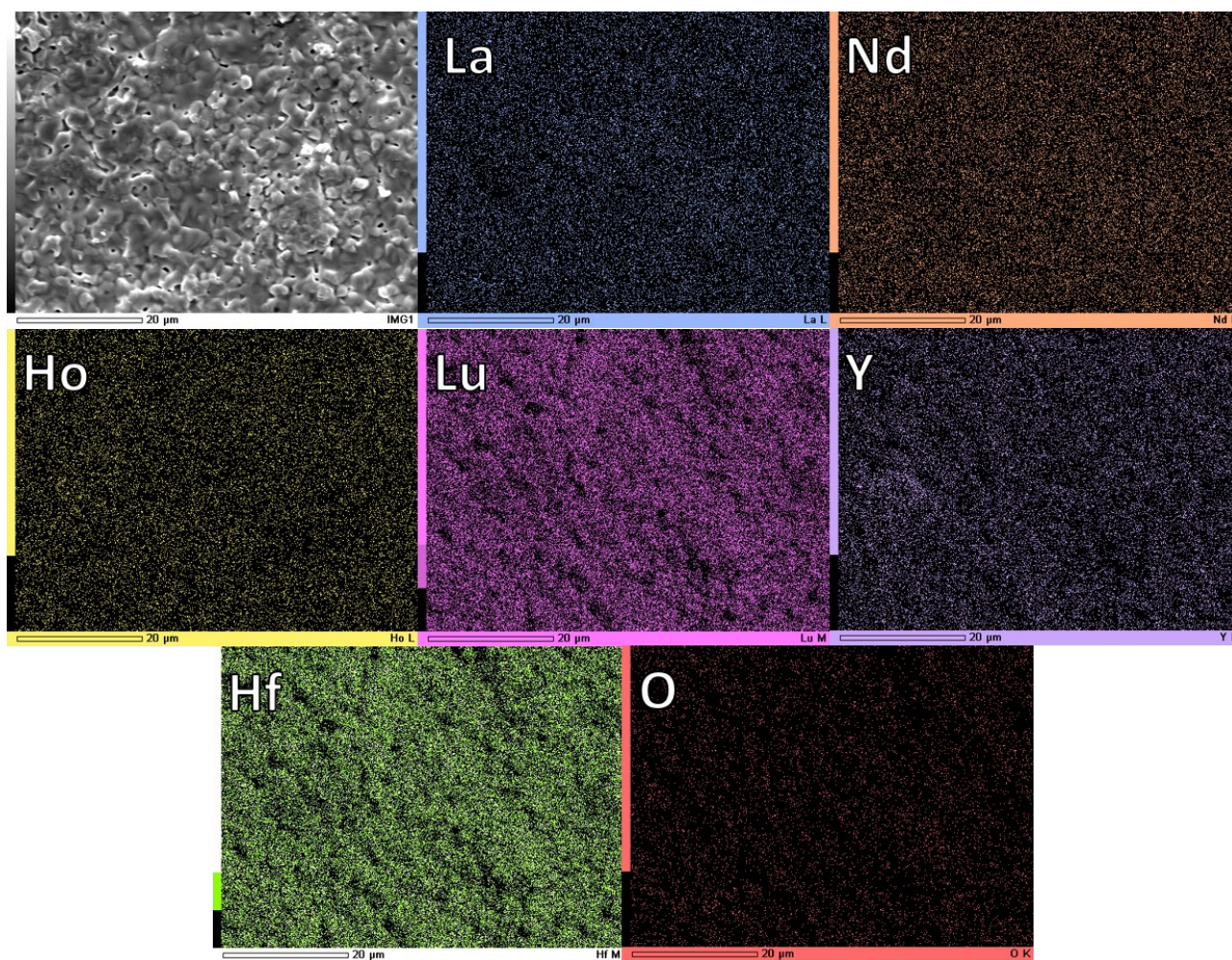


Figure S1a. SEM image and X-ray maps of La, Nd, Ho, Lu, Y, Hf, and O of $(La_{0.2}Nd_{0.2}Ho_{0.2}Lu_{0.2}Y_{0.2})_2HfO_5$, fluorite based HEO composite, synthesized at 1610 °C.

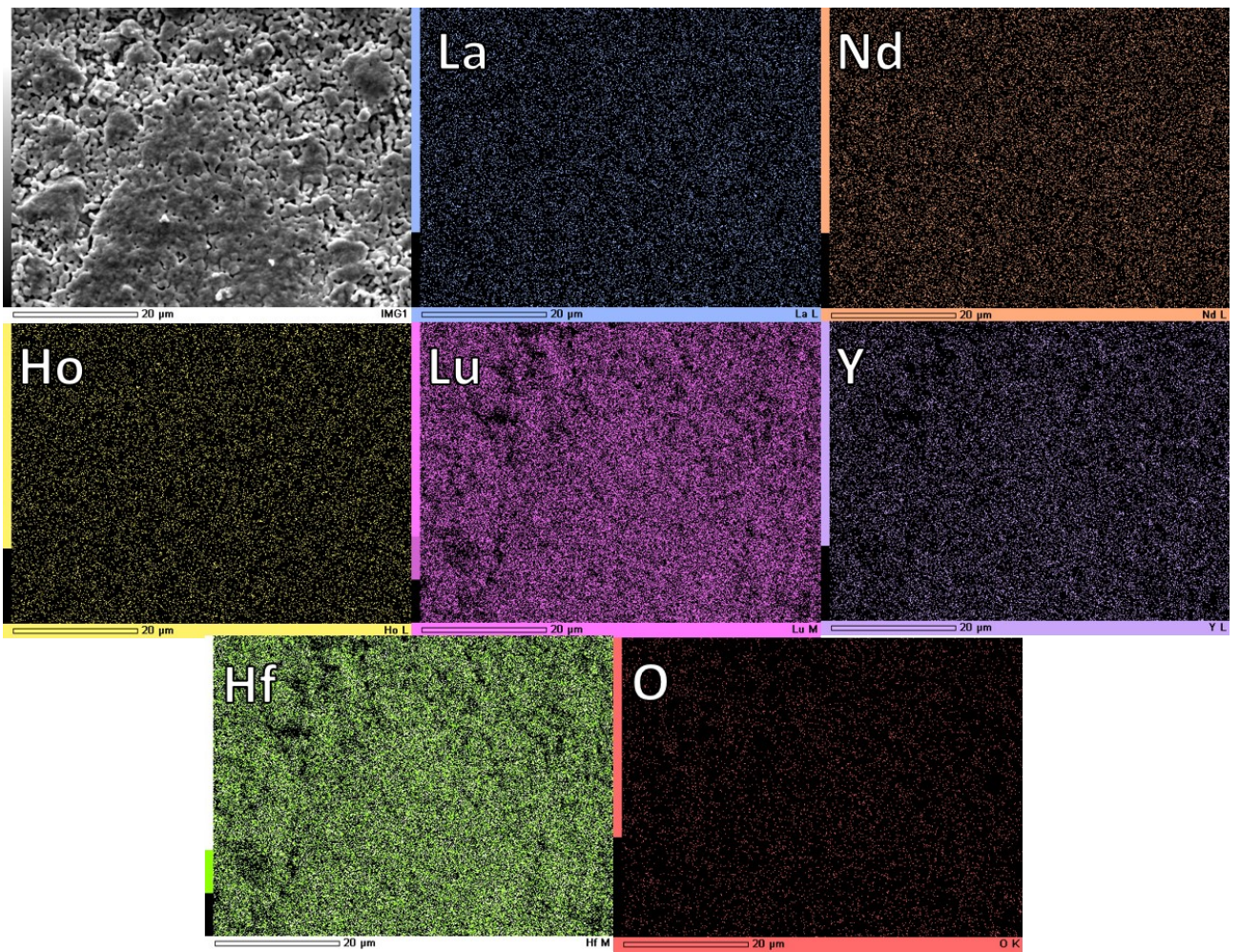


Figure S1b. SEM image and X-ray maps of La, Nd, Ho, Lu, Y, Hf, and O of $(La_{0.2}Nd_{0.2}Ho_{0.2}Lu_{0.2}Y_{0.2})_2Hf_2O_7$, pyrochlore-based HEO composite, synthesized at 1600°C, 4h.

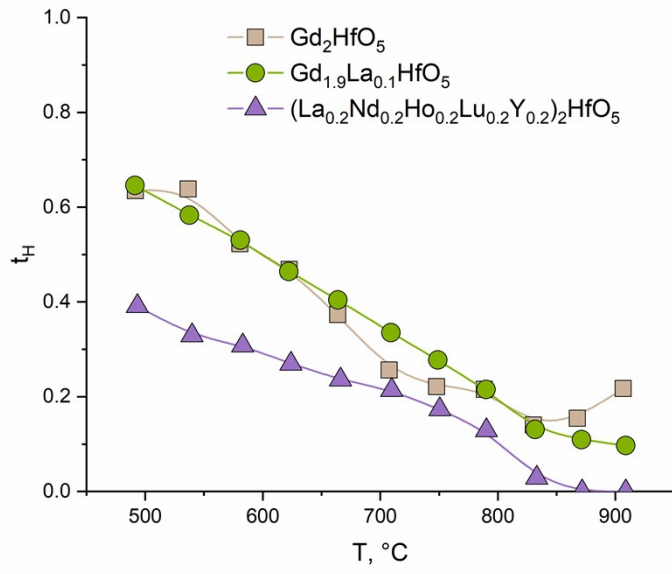


Fig. S2. Proton transfer coefficients in Gd_2HfO_5 , $\text{Gd}_{1.9}\text{La}_{0.1}\text{HfO}_5$, $(\text{La}_{0.2}\text{Nd}_{0.2}\text{Ho}_{0.2}\text{Lu}_{0.2}\text{Y}_{0.2})_2\text{HfO}_5$ ceramics.