

**Supporting Information:** Table of monoclinic lattice parameters for  $\text{Ln}_4\text{Cu}_3\text{MoO}_{12}$  and  $\text{Ln}_2'\text{Ln}_2''\text{Cu}_3\text{MoO}_{12}$  single phases.

Compound	$a(\text{\AA})$	$b(\text{\AA})$	$c(\text{\AA})$	$\beta(^{\circ})$
<b><math>\text{La}_4\text{Cu}_3\text{MoO}_{12}</math></b>	7.908(3)	10.998(1)	6.843(2)	90.01(2)
$\text{La}_2\text{Pr}_2\text{Cu}_3\text{MoO}_{12}$	7.808(2)	11.045(1)	6.763(2)	90.15(3)
$\text{La}_2\text{Gd}_2\text{Cu}_3\text{MoO}_{12}$	7.635(2)	11.171(2)	6.611(2)	90.30(1)
$\text{La}_2\text{Tb}_2\text{Cu}_3\text{MoO}_{12}$	7.623(1)	11.189(2)	6.536(1)	90.35(1)
<b><math>\text{Pr}_4\text{Cu}_3\text{MoO}_{12}</math></b>	7.709(2)	11.086(1)	6.675(2)	90.16(2)
$\text{Pr}_2\text{Eu}_2\text{Cu}_3\text{MoO}_{12}$	7.549(2)	11.165(2)	6.585(2)	90.22(2)
$\text{Pr}_2\text{Dy}_2\text{Cu}_3\text{MoO}_{12}$	7.478(2)	11.219(2)	6.478(2)	90.35(2)
$\text{Pr}_2\text{Ho}_2\text{Cu}_3\text{MoO}_{12}$	7.455(7)	11.234(4)	6.448(7)	90.17(10)
<b><math>\text{Nd}_4\text{Cu}_3\text{MoO}_{12}</math></b>	7.636(1)	11.129(1)	6.608(1)	90.18(1)
$\text{Nd}_2\text{Ho}_2\text{Cu}_3\text{MoO}_{12}$	7.418(2)	11.244(3)	6.424(2)	90.83(2)
<b><math>\text{Sm}_4\text{Cu}_3\text{MoO}_{12}</math></b>	7.501(1)	11.195(1)	6.497(1)	90.17(1)
$\text{Sm}_2\text{Tb}_2\text{Cu}_3\text{MoO}_{12}$	7.422(2)	11.243(2)	6.425(2)	90.26(1)
$\text{Sm}_2\text{Er}_2\text{Cu}_3\text{MoO}_{12}$	7.339(2)	11.277(2)	6.361(1)	90.41(2)
$\text{Sm}_2\text{Tm}_2\text{Cu}_3\text{MoO}_{12}$	7.319(4)	11.280(3)	6.347(4)	90.31(3)
<b><math>\text{Eu}_4\text{Cu}_3\text{MoO}_{12}</math></b>	7.452(2)	11.208(1)	6.452(2)	90.13(2)
$\text{Eu}_2\text{Er}_2\text{Cu}_3\text{MoO}_{12}$	7.323(3)	11.294(4)	6.345(3)	90.60(3)
$\text{Eu}_2\text{Tm}_2\text{Cu}_3\text{MoO}_{12}$	7.279(6)	11.291(4)	6.333(5)	90.04(17)
<b><math>\text{Gd}_4\text{Cu}_3\text{MoO}_{12}</math></b>	7.399(3)	11.286(2)	6.402(2)	90.15(3)
$\text{Gd}_2\text{Ho}_2\text{Cu}_3\text{MoO}_{12}$	7.312(4)	11.293(3)	6.318(4)	90.22(5)
$\text{Gd}_2\text{Er}_2\text{Cu}_3\text{MoO}_{12}$	7.292(4)	11.304(4)	6.312(4)	90.37(4)
$\text{Gd}_2\text{Tm}_2\text{Cu}_3\text{MoO}_{12}$	7.267(4)	11.310(4)	6.293(4)	90.30(4)
<b><math>\text{Tb}_4\text{Cu}_3\text{MoO}_{12}</math></b>	7.331(4)	11.293(3)	6.343(4)	90.25(3)
$\text{Tb}_2\text{Er}_2\text{Cu}_3\text{MoO}_{12}$	7.266(5)	11.323(4)	6.297(5)	90.25(5)
$\text{Tb}_2\text{Tm}_2\text{Cu}_3\text{MoO}_{12}$	7.239(9)	11.336(6)	6.295(9)	90.31(11)
<b><math>\text{Dy}_4\text{Cu}_3\text{MoO}_{12}</math></b>	7.283(4)	11.291(3)	6.289(3)	90.27(4)
$\text{Dy}_2\text{Er}_2\text{Cu}_3\text{MoO}_{12}$	7.236(6)	11.320(4)	6.273(5)	90.17(11)
$\text{Dy}_2\text{Tm}_2\text{Cu}_3\text{MoO}_{12}$	7.221(6)	11.322(4)	6.261(5)	90.02(11)
<b><math>\text{Ho}_4\text{Cu}_3\text{MoO}_{12}</math></b>	7.237(3)	11.292(3)	6.240(13)	90.28(4)
$\text{Ho}_2\text{Er}_2\text{Cu}_3\text{MoO}_{12}$	7.209(4)	11.308(3)	6.244(4)	90.40(3)
$\text{Ho}_2\text{Tm}_2\text{Cu}_3\text{MoO}_{12}$	7.192(3)	11.318(3)	6.234(3)	90.42(3)
<b><math>\text{Er}_4\text{Cu}_3\text{MoO}_{12}</math></b>	7.199(4)	11.308(3)	6.215(3)	90.33(4)
<b><math>\text{Tm}_4\text{Cu}_3\text{MoO}_{12}</math></b>	7.150(5)	11.316(4)	6.189(5)	90.26(5)