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Strongly circularly polarized luminescence from dinuclear Eu(III) helicates prepared through a BINOL-based bis-β-diketone ligands

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Chiral lanthanide helicates have potential applications in biology and material science as chiral probes and circularly polarized luminescence (CPL) materials. However, the preparation of homochiral helicates through coordination-directed self-assembly strategy is challenging due to the greatly labile coordination geometries of lanthanides, which raised the higher requirement for ligand designs. Herein, a BINOL-based bis-β-diketone ligand is developed, which give rise to preorganized helical conformation and induced the formation of homochiral helical structure. X-ray crystallographic analysis reveals that the ligand assemble with Ln(III) ions to give homochiral either P or M quadruple- and triple-stranded helicates, [HNEt3]2+•[Eu_2(BTTB)$_4$]2- and Eu_2(BTTB)3(R/S-BINAPO)2 {(R/S)-BINAPO=(R/S)-2,2'-bis(diphenylphosphoryl)-1,1'-binaphthyl; BTTB=bis[4-(4,4,4-trifluoro-1,3-dioxobutyl)(2,3,5,6-tetrafluorophenoxyl)]-1,1'-binaphthalene}. The ^{1}H, ^{31}P NMR and CD measurements confirm the diastereo purity of the assemblies in solution. A detailed optical and chiroptical characterization reveals that the luminescent enantiopure helicates not only exhibit intense circularly polarized luminescence (CPL) with |glum| values reaching 0.80 but also show high luminescence quantum yields of 72.8%. Our results provide a feasible strategy for designing homochiral helical lanthanide supramolecular architecture and synthesizing excellent CPL materials.

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