**Supplementary Materials**

**Figure S1.** The PXRD pattern of the Nd(form)$_3$ MOF and the three MOFs with varying Nd/Tb ratios.

**Figure S2.** The SEM images showing the larger needle-shaped crystals of the Nd(form)$_3$ MOF (a, average crystal size 50 μm) and the smaller spherical crystals of Eu(form)$_3$ (b, average crystal size 5–10 μm).
**Figure S3.** The PXRD pattern of the Nd(form)$_3$, Eu(form)$_3$ and Tb(form)$_3$ MOF.

**Figure S4.** The luminescence spectrum of the Eu@MIL-103(Nd) MOF showing weak Eu-emission.
Figure S5. $^1$H (top) and $^{13}$C (bottom) NMR spectrum of a selected cis-regular polyisoprene sample (run 3, solvent CDCl$_3$ labelled as S).
**Figure S6.** The SEM image of run 3 polymer sample showing dispersed MOF particles.

**Figure S7.** The quenched luminescence spectrum of the sample polymer 17 produced using the Eu@MIL-103(Nd) MOF as pre-catalyst.