Design and synthesis of luminescent lanthanide complexes with a luminescence OFF/ON switch

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Luminescent lanthanide sensors are of current interest and much effort has been devoted to designing luminescent sensors. However, there is no coherent strategy available for this purpose. So, we here present a practical strategy. We employed the PeT (photoinduced electron transfer) mechanism as a basis for luminescence switching and synthesized lanthanide complexes [Ln-1]-[Ln-12] with various luminescence off/on switches. We showed the luminescence intensity can be predicted from the HOMO level of the off/on switch. i.e, the HOMO levels of luminescent complexes were below -5.80 eV and those of non-luminescent complexes were more than -5.80 eV. These results show we can develop novel luminescent sensors by choosing an off/on switch which steps across the threshold upon reaction with the target analyte. In addition, [Ln-1] shows a large pH-dependent luminescence enhancement; [Ln-1] emission is switched on in acidic media, with a pKₐ of 4.6 for [Eu-1] and 3.6 for [Tb-1]. This result shows [Ln-1] works as pH sensor. This strategy should be applicable to develop a range of luminescence probes which can recognize various target molecules.