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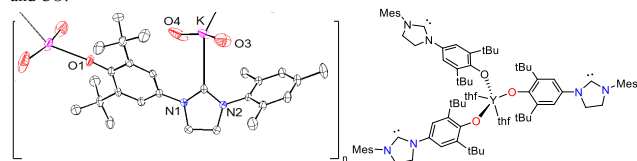
## Synthesis and Reactivity Study of Rare Earth Metal Aryloxy-Tethered N-heterocyclic Carbene (NHC) Complexes

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N-Heterocyclic carbenes (NHCs) are two electron donors which contain a neutral, divalent,  $sp^2$ -hybridised carbon centre. The strongly nucleophilic lone pair on carbon renders NHCs strong  $\sigma$ -donors, exhibiting high Lewis basicities, and consequently, they have emerged as components for the construction of highly reactive frustrated Lewis pairs (FLPs) and metal complexes for homogeneous catalysis and small molecule activation. Over the last 25 years, organometallic compounds of the rare earth metals have shown many interesting small molecule activation reactions, including hydrocarbon C-H bond cleavage.

Herein we report the synthesis and small molecule activation of a new class of aryloxy-tethered N-heterocyclic carbene complexes in which carbenes are remote from the metal. Deprotonation of aryloxy-tethered imidazolium proligand ( $H_2LBr$ ) yields  $[KL]_n$  **1**, which has been structurally characterised, Figure 1. Reactions of the KL salt with rare earth metal halides afford a series of complexes including **2**, Figure 1.

We will present the reactivity of these complexes towards small molecules including  $CO_2$  and  $CO$ .



**Figure 1.** Crystal structure of  $[KL(thf)_2]_n$  **1** (O atoms only of thf shown) and drawing of  $REL_3$  **2**. RE = rare earth metal.

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## Synthesis and luminescence properties of $TiO_2@SnO_2$ nanoparticles doped with terbium

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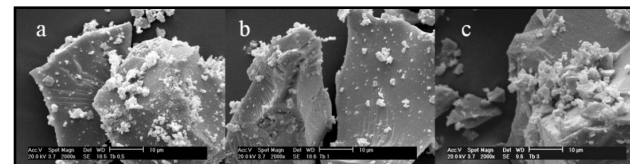
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The mixed-metal oxide has been applied in many function materials as gas sensors, batteries, hybrid solar cells, heterogeneous catalysts or catalyst support. Various metals oxide were widely studied for researches, among these, tin and titanium dioxide have received attention mainly because their photocatalytic activity and optical properties.<sup>1-4</sup>

In this work, tin/titanium mixed oxide doped with terbium (0.005, 0.01 and 0.03 molar fraction), were synthesized by co-precipitation method and characterized with thermogravimetric analysis, X-ray powder diffraction (XPD), X-ray Absorption Spectroscopy (XAS), scanning electron microscopy (SEM) and transmission electron microscopy (TEM) techniques. The luminescence properties of  $SnO_2/TiO_2:Tb^{3+}$  were investigated by photoluminescence spectroscopy at room temperature 300 K and 77 K.

The thermogravimetric analysis showed thermal stability of the luminophores. The XPD analysis confirmed a mixture of cassiterite (ICDD PDF-002-1340) phase from tin and anatase of  $TiO_2$  (ICDD PDF-021-1272). In addition, a trace of  $Tb_2Sn_2O_7$  phase (JCPDS 013-0188), which confirm the samples as a pure tetragonal rutile crystalline phase (cassiterite phase). The XANES analyses of the Tb *LIII* edges indicate that this rare earth dopant is present in the trivalent state and The analyses of the EXAFS data yielded important information on the interatomic distances around terbium.

The photoluminescent data suggest efficient energy transfer from matrix to ion terbium and the  $^5D_4 \rightarrow ^7F_5$  hypersensitive transition is the most prominent. Furthermore, the relative intensity of the broad band, in excitation spectra, is higher than those that were centered on the  $Tb^{3+}$  ion and this intensity is inversely proportional to  $Tb^{3+}$  concentration. Therefore, the  $TiO_2@SnO_2:Tb^{3+}$  nanoparticles exhibit intense green emission under radiation and can be applied in several areas as photocatalytic supports and photonic materials.



**Figure 1.** SEM of  $SnO_2/TiO_2:Tb^{3+}$  with xTb: a) 0.005, b) 0.01 and c) 0.03.

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