Efficient Light-emitting Materials for OLED Devices

Patent Title:	Luminescent Gold (III) Compounds, Their Preparation, and Light-emitting Devices Containing Same
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This invention provides a novel class of luminescent gold (III) compounds for making efficient light-emitting materials for Organic Light-Emitting Diodes (OLEDs).

Market Opportunity

There is a huge market potential for phosphorescent OLEDs in the display and solid-state lighting industry, but most of the iridium-based patents are held by a few market players. Both local and international companies therefore would benefit from the introduction of gold-based phosphors. According to a market research report released by NanoMarkets in 2011, the global OLED lighting market is estimated to reach US$ 4.8 billion by 2016. In particular, NanoMarkets estimated that architectural applications of OLED lighting and larger OLED panels for automotive applications will generate more than US$ 950 million and US$ 805 million respectively in revenues by 2016 [1].

The HKU Invention

Through the introduction of strong donor ligands into gold (III) metal center, a novel class of luminescent gold (III) compounds is produced. Specifically, this invention provides a novel class of luminescent neutral cyclometalated gold (III) alkynyl complexes, [Au(C^N^C)(CMC–R)]. This invention also demonstrates that the incorporation of a strong s-donating alkynyl ligand into the [Au(C^N^C)] moiety would enrich the photoluminescence properties. The new compounds can be used in the role of both emitters and dopants, which enables OLEDs to give electroluminescence with high brightness and efficiency.

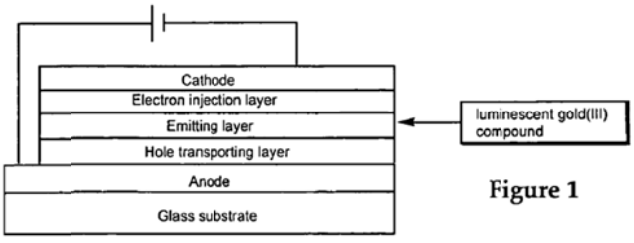

Figure 1

As shown in Figure 1, with the incorporation of luminescent gold (III) compounds in the emitting layer, a device with this structure can exhibit a high external quantum efficiency of 12.8%. In addition, the utilization of the gold (III) compounds as electrophorescent dopant in the fabrication of multilayer OLEDs also gives a respectable external quantum efficiency of 5.5%. This invention will open up an entirely new class of electrophosphorescent materials containing alternative metal centres that are as efficient as iridium and more efficient than the platinum metals being used currently.

Furthermore, gold (III) compounds also have the following advantages over the currently used iridium, platinum and osmium complexes:

- an intense low-energy electronic absorption band in the visible range, which can be easily fine-tuned by the modification of substituents on the auxiliary ligand;
- strong photoluminescence in various media at both ambient and low temperatures;
- a broad colour-tuning possibility, that is comparable to cyclometalated iridium (III) complexes and superior to platinum (II), ruthenium(II) and osmium(II) systems; and
- neutral and stable towards sublimation and not prone to isomerization with decomposition temperature of 300 – 350 °C.

About the Lead Inventor

The lead inventor of this invention is Prof Vivian Wing-Wah Yam, who was honoured as Laureate in the 13th L'Oréal-UNESCO Women in Science Awards 2011 in recognition of her contributions on light-emitting materials and innovative ways of capturing solar energy. Prof Yam's major research focus is in the molecular design and synthesis of novel inorganic and organometallic metal complexes that may find potential applications as functional metal-based molecular materials. Her seminal works on luminescent polynuclear metal complexes and clusters and light-emitting carbon-rich organometallics have gained her substantial international recognition. Prof Yam is an Academician of the Chinese Academy of Sciences and a Fellow of the Academy of Sciences for the Developing World. She has also been awarded a Royal Society of Chemistry (UK) Centenary lectureship and medal.

References

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