Gold Complexes for Materials Applications and Anti-Cancer Medicines

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The research on gold complexes has been expanding rapidly over the past few years due to their applications in areas such as catalysis, materials sciences, and therapeutic applications. Because of the electrophilicity of gold(III), the emissive excited states of gold(III) complexes usually have a small radiative decay rate ($k_r$), leading to emission with lifetime over 100 $\mu$s in solutions at room temperature. These highly emissive, long-lived excited states render these gold(III) complexes capable of acting as catalysts for photo-induced reactions, sensitizers for energy up-conversion, and emitters in OLEDs.

Very recently, we developed a class of pincer gold(III) aryl complexes exhibiting thermally activated delayed fluorescence (TADF) with quantum yields of up to 0.79 in solution and 0.84 in thin films (4 wt% in PMMA) at room temperature, both of which are the highest reported values among gold(III) complexes. Solution-processed OLEDs fabricated with these complexes showed sky-blue to green electroluminescence with external quantum efficiencies (EQEs) of up to 23.8%, current efficiencies of up to 70.4 cd A$^{-1}$, and roll-off of down to 1%.

The distinct structural properties and reactivity of gold(III) coordination compounds also provide considerable potential for the diagnosis and therapy of cancer. Ligands with N and/or C donor atoms such as dianionic porphyrinato and N-heterocyclic carbenes (NHC) ligands can be used to construct lipophilic, cationic gold(III) complexes with good stability and cell permeability under physiological conditions. A number of our gold(III) complexes show promising anti-cancer activities. For example, gold(III) porphyrin complexes display potent cytotoxicity toward cancer cells including those cisplatin- and multidrug-resistant ones, and exhibit in vivo anti-tumor activities in mice models of cancer. Further formulation of the gold(III) porphyrin with cleavable PEGylation results in self-assembled nanostructures that improve delivery to tumor and reduce systemic toxicity. For the molecular target identification, we have prepared click chemistry and photoaffinity probes of gold(III) porphyrin and cyclometalated gold(III) NHC complexes, and identified the engaged targets through chemical proteomics with verifications by biological experiments.

References


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