



Official Journal of TESMA

Regenerative Research

www.regres.tesma.org.my
E-ISSN 2232-0822

Tissue Engineering
and Regenerative
Medicine Society of
Malaysia

Regenerative Research 7(1) 2018 153

SYNTHESIS OF MOLECULAR ASSEMBLY NEAR-INFRARED PHOSPHORESCENT HYBRID NANOMATERIALS FOR BIOIMAGING APPLICATIONS

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ARTICLE INFO

Published: 26th August 2018

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KEYWORDS

Gold(I) Triazole Complex;
Molecular Self-Assembly;
Near-Infrared
Phosphorescent (NRIP);
Optical Bioimaging

SUMMARY

Fundamental research in near-infrared phosphorescent (NRIP) using molecular assembly of phosphorescent heavy-metal complexes is a subject of intense investigation for developing device such as optical imaging (bioimaging), laser and optical amplifications. Surprisingly, these materials exhibit high luminescence efficiency, can easily be realized at the whole visible near-infrared range of the tunable excitation and emission wavelength and also significantly displayed Stokes shift more than 5000 cm⁻¹ for easily distinguishing emission over excitation and eliminating self-quenching processes. Therefore, in the arena of optical bioimaging with a unique position, highest sensitivity and spatial resolution, fluorescent probe is the only technique which provides cellular or molecular level information with almost single-molecule sensitivity. To improve detection sensitivity in optical imaging, a large number of NIRP molecules must assemble and hybridize into nanoscale matrix to form an intense phosphorescence nanoprobe. Although phosphorescent trinuclear gold(I) (Au(I)) triazole complex has been reported in a solid state with luminescence center at 750 nm at room temperature, no example of NIRP assembled molecules confined in the nanoscopic channel of mesoporous silica has yet been reported so far. Therefore, a hybrid nanomaterial in NIRP of trinuclear Au(I) triazole complex ([Au³Tz³]) has been develop in the silicate nanochannels of mesoporous silica using sol-gel synthesis method for fully incorporation of the NIRP molecules. In order to synthesize the complexes, 17% of amphiphilic triazole ligand C₁₀TEGTzH (step 4; 0.11 g) was successfully prepared in three stepwise reactions from C₁₀TEBr (step 1; 6.80 g, 57%), C₁₀TEGBnCOOMe (step 2; 2.85 g, 62%), C₁₀TEGBnCOOH (step 3; 1.20 g, 69%). In step 5, ([Au³Tz³]) was synthesized using the resulting C₁₀TEGTzH as a reagent in the presence of gold salt ([Au(Me₂S)Cl]) in dry tetrahydrofuran (THF) and potassium hydroxide (KOH) in dry methanol (MeOH) with Schlenk technique. [Au³Tz³] was isolated as a pale-yellow sticky oil in 56% (61.3 mg) by using column chromatography.

Acknowledgement: The authors thanks Ministry of Higher Education (MOHE) through Fundamental Research Grant Scheme (FRGS), Universiti Teknologi Malaysia, UTM Malaysia for the financial support, Ministry of Science, Technology and Innovation (MOSTI) through National Nanotechnology Directorate (NND), Malaysia for NanoFund Grant and Flagship Research Grant for NanoMalaysia CoE for providing fluorescent spectrophotometer.