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Enhancing the sensitivity and spatial imaging resolution of a hybrid x-ray imaging screen via energy transfer at the zns (ag)-tadf interface

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Novel scintillation materials have played an indispensable role in the recent remarkable progress witnessed for X-ray imaging technology. Herein, a high-performance X-ray scintillation screen was developed based on a highly efficient hybrid system combining inorganic ZnS (Ag) with thermally activated delayed fluorescence (TADF) scintillator materials via an interfacial energy transfer (EnT) mechanism. ZnS (Ag) has a high X-ray absorption capacity and functions as the initial layer for efficiently converting high-energy X-ray photons into low-energy visible light (acting as a sensitizer) while also serving as an energy donor. The TADF component, on the contrary, is an energy acceptor and forms an active scintillating layer. By harnessing TADF chromophores that can efficiently capture both singlet and triplet excitons, our composite material offers a remarkable spatial imaging resolution of 24 line pairs per millimeter, surpassing those of the majority of existing organic and inorganic scintillators. Further, our interfacial energy transfer strategy effectively amplifies the radioluminescence intensity of the TADF scintillator by a factor of 75, offering an outstanding light yield of 38,000 photons/MeV. This advancement represents a remarkable breakthrough in organic X-ray scintillation technology and is a notable achievement within the X-ray imaging field, paving the way for novel applications in medical imaging and security inspection.

Biography

Shorooq Abdulrhman Alomar is a KAUST Ph.D. candidate in Materials Science and Engineering, supervised by Professor Omar F. Mohammed. Her research explores carrier dynamics and energy transfer systems in optoelectronic materials to improve imaging and energy conversion technologies.

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