Study of C_{60} fullerene photoinduced functionalization for room temperature single photon generation

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C_{60} fullerene embedded in polystyrene exhibits on-demand single-photon emission at room temperature, making it a promising candidate for scalable quantum communication devices [1]. However, pristine C_{60}'s icosahedral symmetry suppresses the lowest-energy HOMO-LUMO transition, predicting negligible photoluminescence. It has been hypothesized that photo-oxidative functionalization, forming $C_{60}O_n$ species, breaks the molecular symmetry and activates previously forbidden transitions [2]. To test this idea, we study thin films of C_{60} embedded in a polystyrene matrix under continuous 405 nm excitation, to monitor spectral evolution.

Upon irradiation, the photoluminescence spectrum undergoes measurable changes (Figs. 1 and 2) before reaching saturation, consistent with progressive functionalization of individual C_{60} molecules. Control experiments show that neither pure polystyrene nor pristine C_{60} films exhibit similar spectral changes under identical conditions. These observations support the inference that photo-oxidative functionalization requires both C_{60} and the polymer matrix and is responsible for the observed emission. Identifying the dominant $C_{60}O_n$ species and clarifying the detailed functionalization mechanism will guide the design of future C_{60}-based quantum light sources.

References

[1] R. Lahoz et al, Nano Letters 25, (2025) 15048-15054.
[2] C. Zhang et al, Physics Letters 68, (1996) 943-945.

Figures

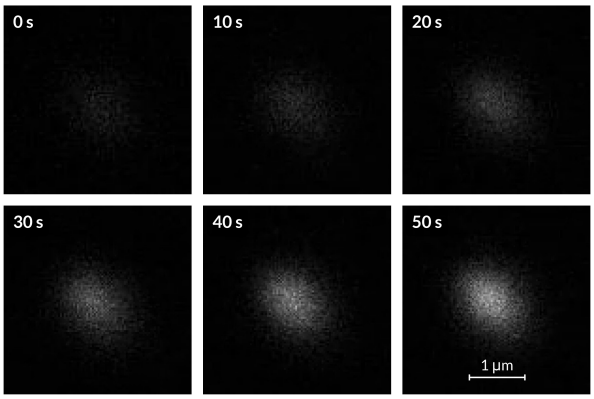

Figure 1: Micrographs showing the photoluminescence intensity increase when a thin film of C_{60} embedded in a polystyrene matrix is continuously irradiated with a 405 nm laser.

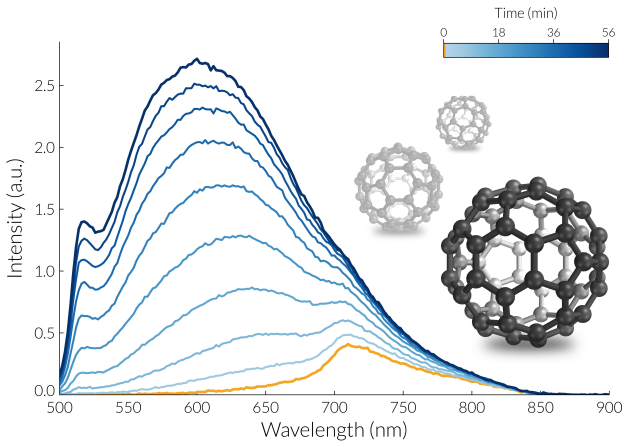

Figure 2: The photoluminescence spectrum of the sample shifts from approximately 710 nm to 600 nm and the intensity increases by a factor of four. The yellow trace corresponds to the spectrum of pristine C_{60}.