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2021

Nair, R. V., Padmanabhan, P., Gulyás, B. & Murukeshan, V. M. (2021). Fluorescence resonance energy transfer (FRET)-based ThT free sensing of beta-amyloid fibrillation by carbon dot-Ag composites. Plasmonics, 16(3), 863-872. https://dx.doi.org/10.1007/s11468-020-01338-w

https://hdl.handle.net/10356/148602

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Fluorescence energy transfer-based ThT free sensing of Beta-amyloid fibrillation by carbon dot – Ag composites

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Supplementary data

1. Excitation dependent emission spectrum of carbon dots

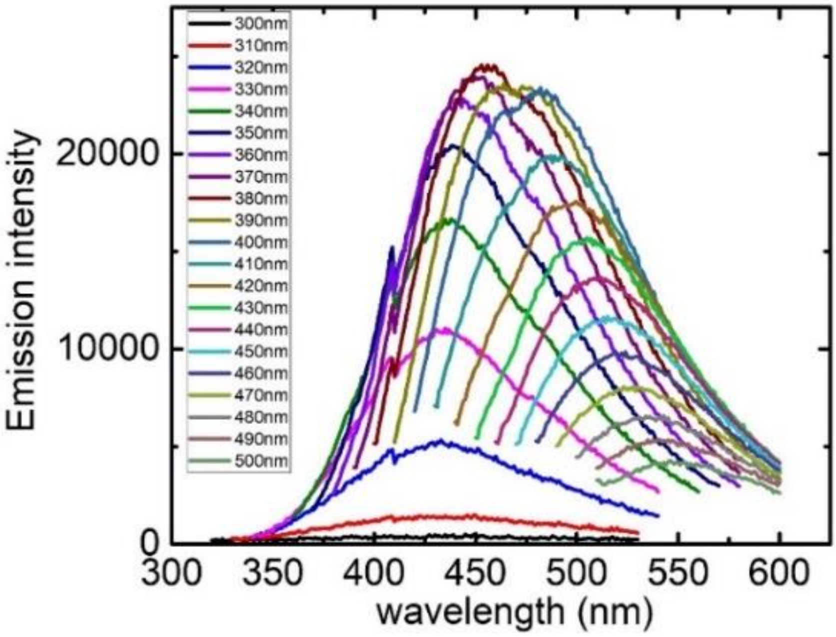


Figure S1: Excitation dependent emission spectrum of carbon dots

Excitation dependent emission spectrum of carbon dots is shown in figure S1. Excitation wavelength is varied from 300 nm to 500 nm in steps of 10 nm and corresponding emission spectra are recorded. Deuterium lamp is used for UV excitation of samples. Tungsten lamp is used for visible light excitations. Emission wavelength is observed to tunable over the range 400 nm to 560 nm with the increase in the excitation wavelength. The strongest emission (460 nm) is observed at an excitation wavelength of 380 nm. Emission intensity gradually increases till the excitation of 380 nm and beyond which it gradually reduces. Such a multicolor emission from carbon dots is attributed to sp^2 hybridized levels and various functional groups, surface states and zigzag states present in carbon dots [1].

2. Quantum efficiency calculation of carbon dots

Quantum efficiency calculation of carbon dot emission is performed based on relative fluorescence intensity measurement using Rhodamine 6G (Rh6G) (at 550 nm emission peak at an excitation wavelength of 530 nm) as reference standard dye. Quantum efficiency of carbon dots is calculated as 31.6%.

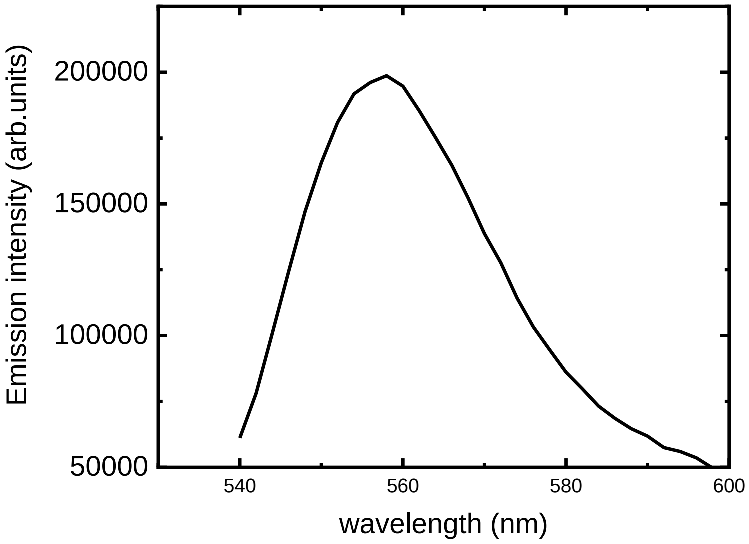


Figure S2: Emission spectrum of Rh6G at an excitation wavelength of 530 nm

3. Emission spectrum of carbon dots at 450 nm laser excitation

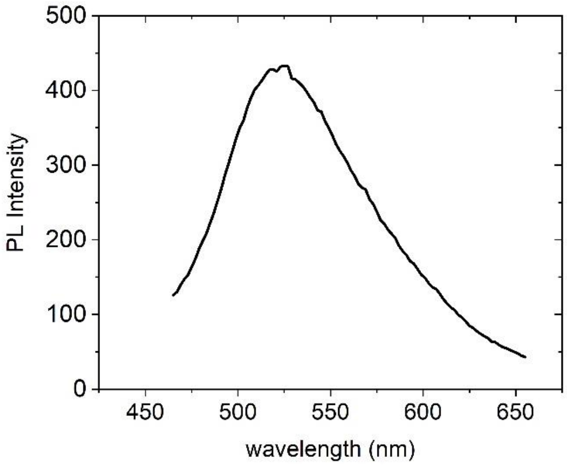
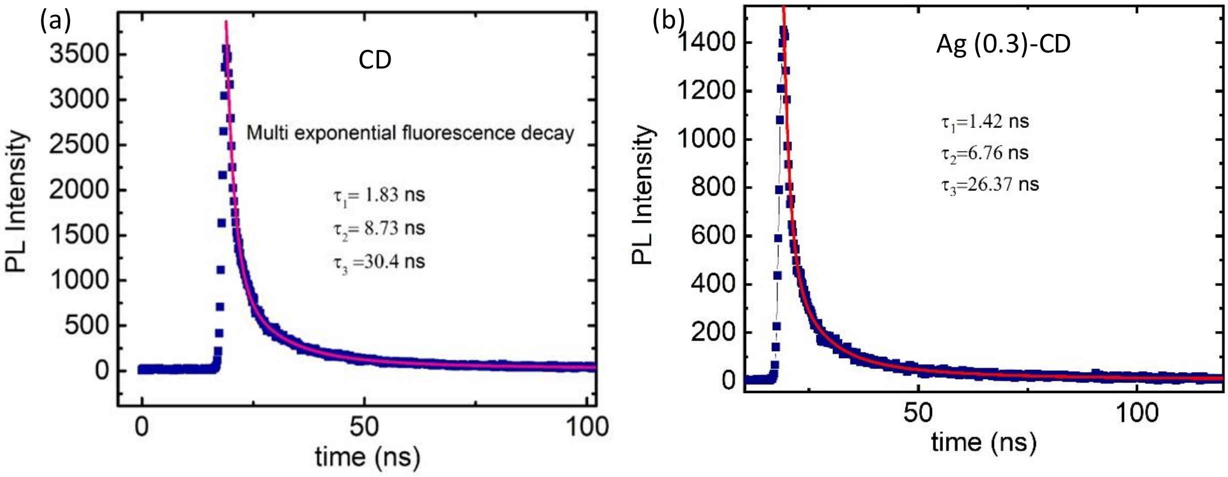


Figure S3: Emission spectrum of carbon dots at 450 nm laser excitation

Emission spectrum of carbon dots at 450 nm laser excitation is shown in figure S3. Emission peak is observed at 525 nm.

4. Comparison of fluorescence life time measurements of carbon dots and Ag (0.3)-carbon dot composite



FigureS4: Fluorescence life time plot of carbon dots (a) and Ag (0.3) – carbon dot composite (b)

Fluorescence life time measurements of carbon dots (figure S4 (a)) and Ag (0.3) – carbon dot composite (figure S4 (b)) are performed using picosecond pulsed diode laser of wavelength 450 nm with 1 MHz pulse repetition rate as the excitation source and the corresponding emission is collected by Time correlated Single Photon Counting (TCSPC) system (Edinburgh instruments). The decay curve obtained is found to fit well with the tri-exponential decay function. The fluorescence life time values obtained for carbon dot are 1.83 ns, 8.73 ns and 30.4 ns (average life time = 13.6 ns) and for Ag (0.3)-carbon dot composite are 1.42 ns, 6.76 ns and 26.37 ns (average life time = 11.5 ns). Reduction in the average fluorescence lifetime of carbon dots in the presence of Ag nanoparticles indicates the possibility of an additional decay path due the effective plasmonic coupling of carbon dots with Ag nanoparticles [2].

5. TEM images of various beta amyloid fibrillation stages

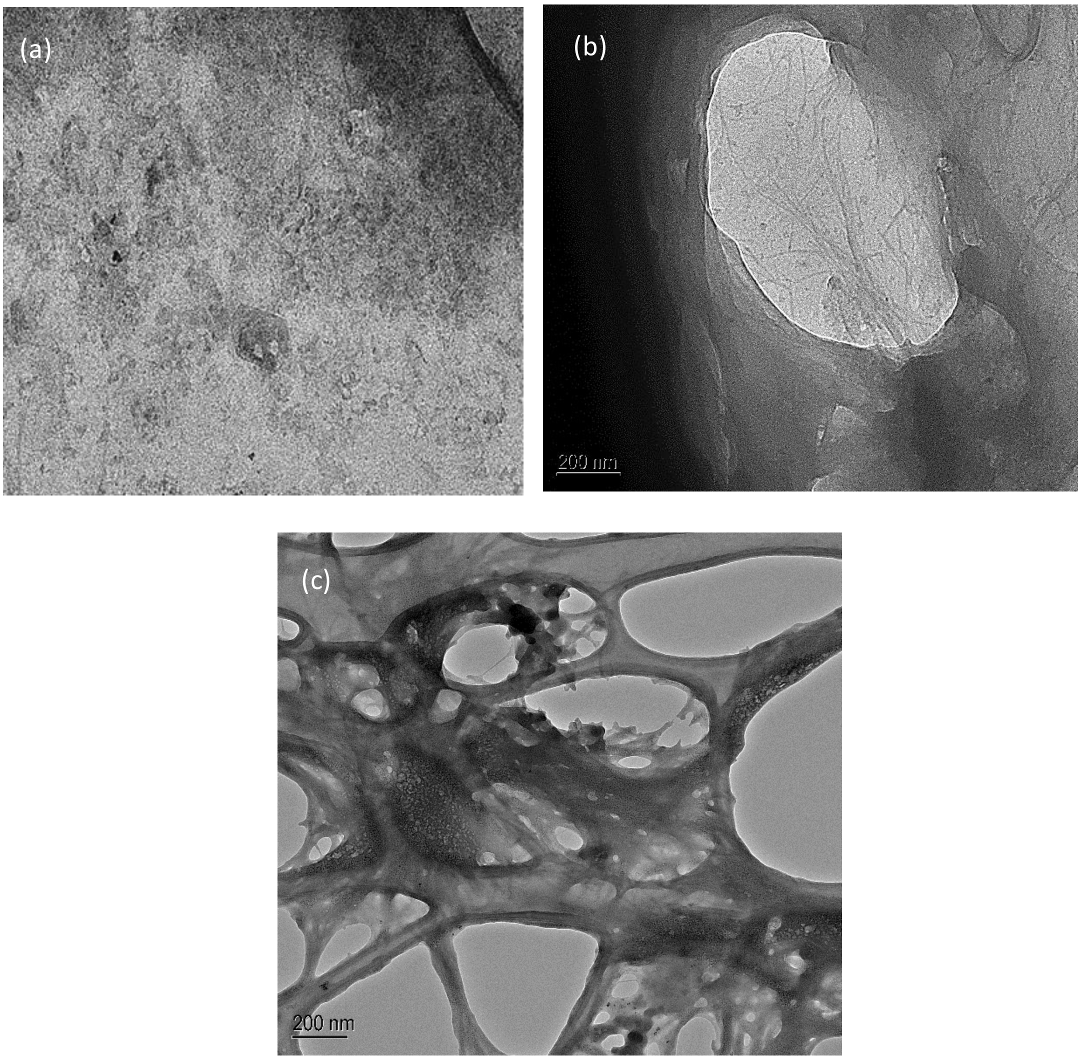


Figure S5: TEM image of beta amyloid in lag phase (a), growth phase (b) and steady phase

Figure S5 shows TEM images of various fibrillation stages of Aβ_{1-42}. Figure S5(a) completely lacks the presence of any fibrils indicating the lag phase where Aβ_{1-42} still maintains the monomeric phase. Small fibrils are observed to be present along with a few monomers in figure S5(b) indicating the growth phase. Figure S5(c) is devoid of monomers and shows long beta amyloid fibrils representing the steady phase where the monomeric aggregation to fibrils is completed.

References

1. F Yan, Z Sun, H Zhang, X Sun, Y Jiang, Z Bai, Micrichimica Acta, **186** (2019)

2. Y Choi, P Joo, T Kim, B Ram Lee, *Nat. Photonics,***181** (2013)