Multi-colored Emissive Carbon Dots for Generation of Pure White Light

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The rare-earth and toxic metal-free single component pure white light emiiter (WLE) has been strongly required in our society due to environment point of view. But efficient effecient dircet WLE is still a grand challenge. Recently, fluorescent carbon dots (CDs) has emerged as a new class of materials that are composed mainly of C, O, H which is completly metal-free. It display emission poroerty in enirite visible spectra depned on the surface states, size and doing. The emission property is tuned by the doping centre and surface functional groups leading to multi-coloured emission. Various types of CDs have been developed with desired emission properties, through a wide range of organic precursors. The systematic investigation of the N-doping centres and surface functional groups has provided a vital role of the emission property. For example, it was predected that, graphitic N centre triggers the red emission from the CDs. The optimiezed synthetic strategy enabled us to tune the N centres and lead to the broadband emission as a result direct WLE in the entire visible spectra (400 to 750 nm). The decrease or increase of the different N doped centres into the CDs led to the green to orange emission, respectively. Because the graphitic N creates mid-gap states within the HOMO−LUMO gap of the pristine CDs, as a result, the light absorption is red-shifted which gives rise to the low energy fluorescence in the visible spectrum. Rationally designed optiumized the N doping centres into the CDs which controlloed the emission such as way to produces the direct WLE. As synthesized CDs show dierect and ideal WLE both in solution and in solid forms with CIE coordinates value of (0.34, 0.35) and high colour rendering index (CRI 92). These CDs can form transparent and efficient WLE film with long term stability, when they are mixed in the polymer matrix and excited via UV light. This study provides an important guiding princiles for CDs syntheses for realizing spectrally tuned emission and single component direct WLE.

REFERENCES

[1] K. Hola, M. Sudolska, S. Kalytchuk, D. Nachtigallova, A.L. Rogach, M. Otyepka, R. Zboril, ACS Nano, 11 (2017) 12402.
[2] X. Miao, D. Qu, D.X. Yang, B. Nie, Y.K. Zhao, H.Y. Fan, Z.C. Sun, Adv Mater, 30 (2018) 1704740.
[3] F. Arcudi, L. Đorđević, M. Prato, *Angew. Chem. Int. Ed.* 56 (2017) *56*, 4170.

FIGURES

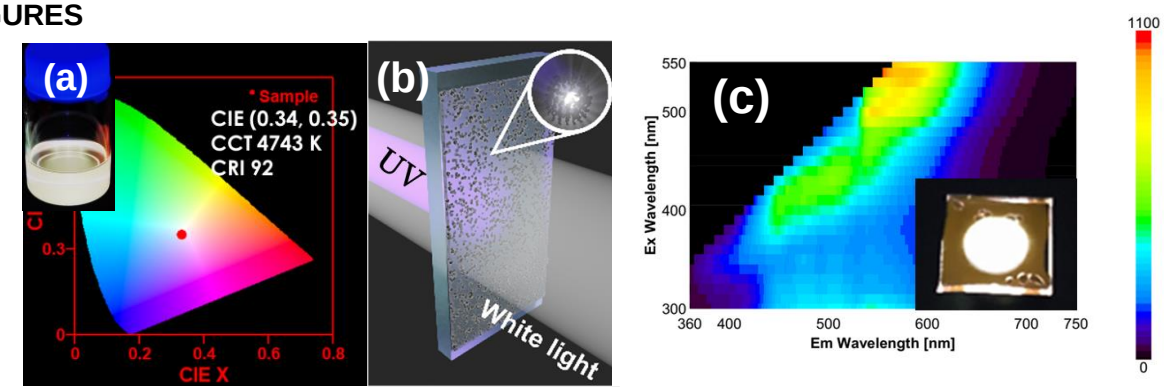

Figure 1: (a) CIE coordinates value (0.34, 0.35) of dircet and pure WLE CDs. (Inset shows the WLE from collodial CDs solution). (b and c) Schematic representaion and demonstration of direct WLE from the CDs in polymer matrix.