Clustering & Global Challenges

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

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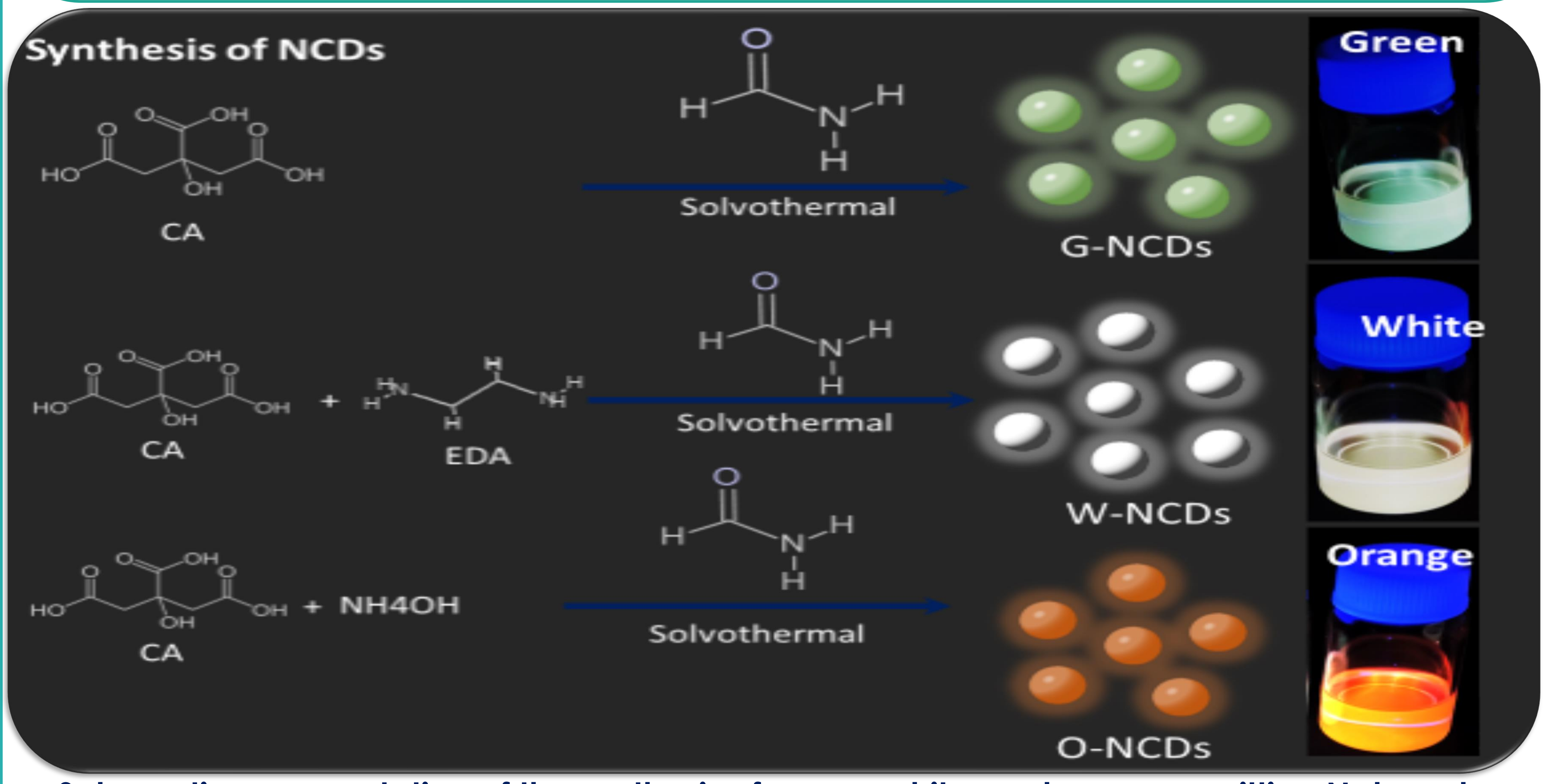
Introduction

- ☐Toxicity of inorganic QDs (CdS, CdSe, CdTe, PbS, PdSe etc.) and perovskites, limits their applications in biological environments
- ☐Due to the limitation of the rare earth metals, an alternative is essential for near future
- ☐Carbon dots can be an ideal alternative new luminescent material made-up of C, O, H, and N. Generally non-toxic and completely metal-free
- ☐Due to its discrete structure, tunable properties, low toxicity and low cost, CDs differ from inorganic QDs or rare earth doped phosphors

Aim

Rationally designed and optimized N doping centres into the CDs which control the emission to produce the direct and pure white light emission (WLE)



Schematic representation of the synthesis of green, white, and orange emitting N doped Carbon dots (NCDs) via solvothermal reaction

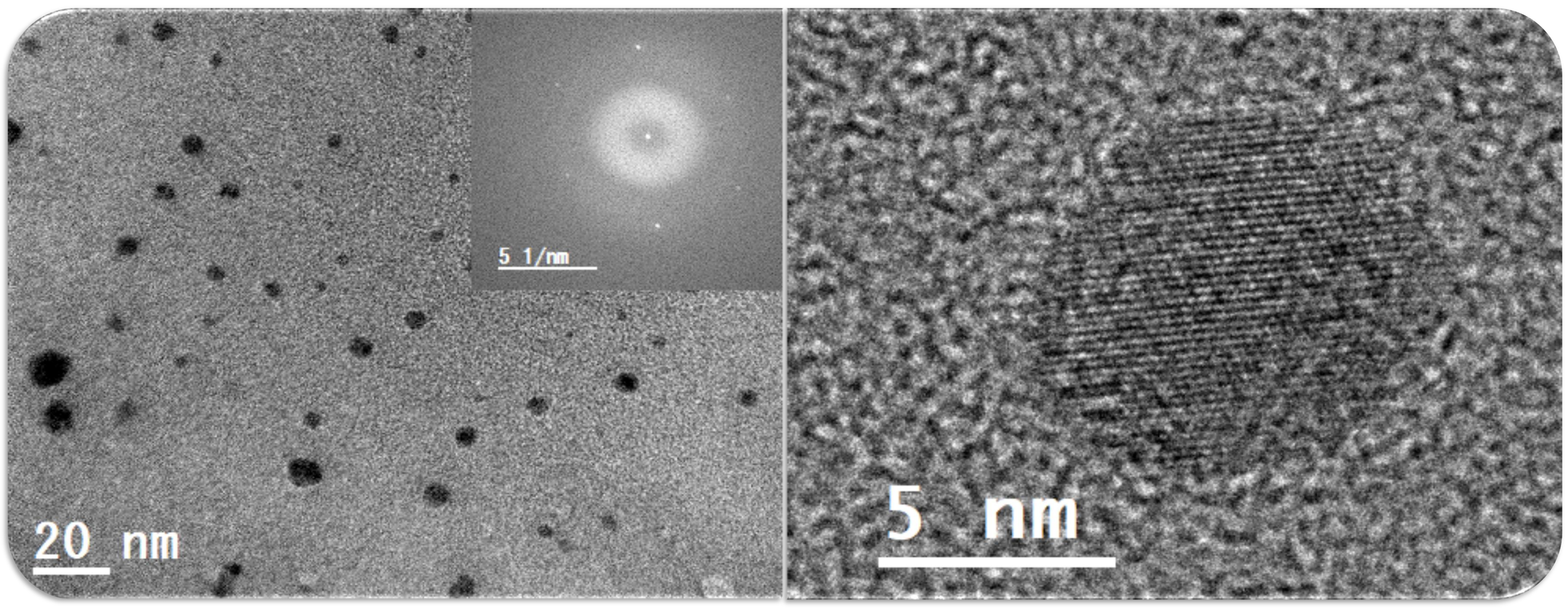


Fig.2 TEM and HRTEM image of W-NCDs. The inset figure shows the high crystalline nature of NCDs

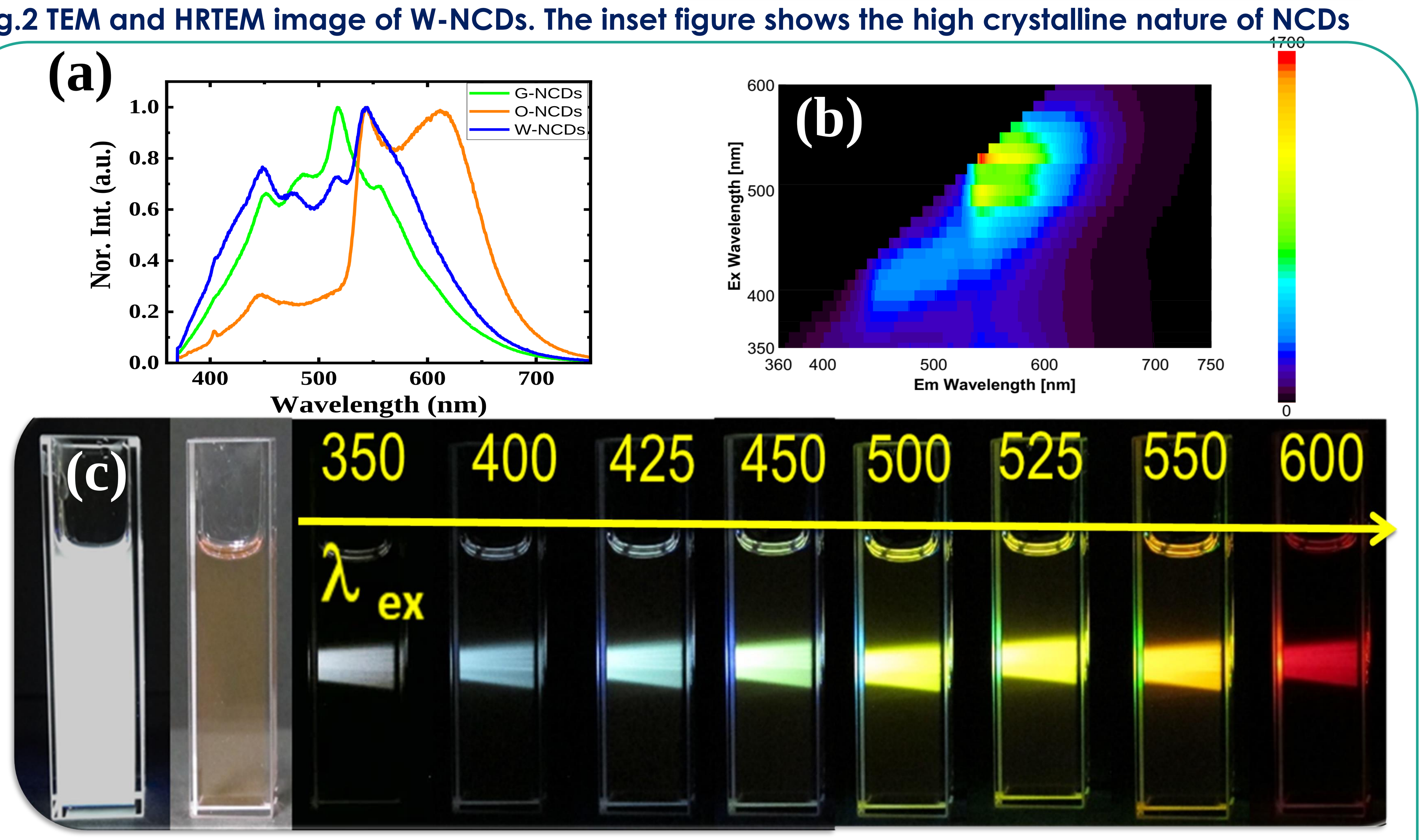


Fig. 3 (a) Emission spectra of G, W, and O emitting NCDs. (b) 2-D excitation and emission spectra of W-NCDs.(c) WLE via UV light excitation and photograph of the solution. Multicolor emission via different excitation.

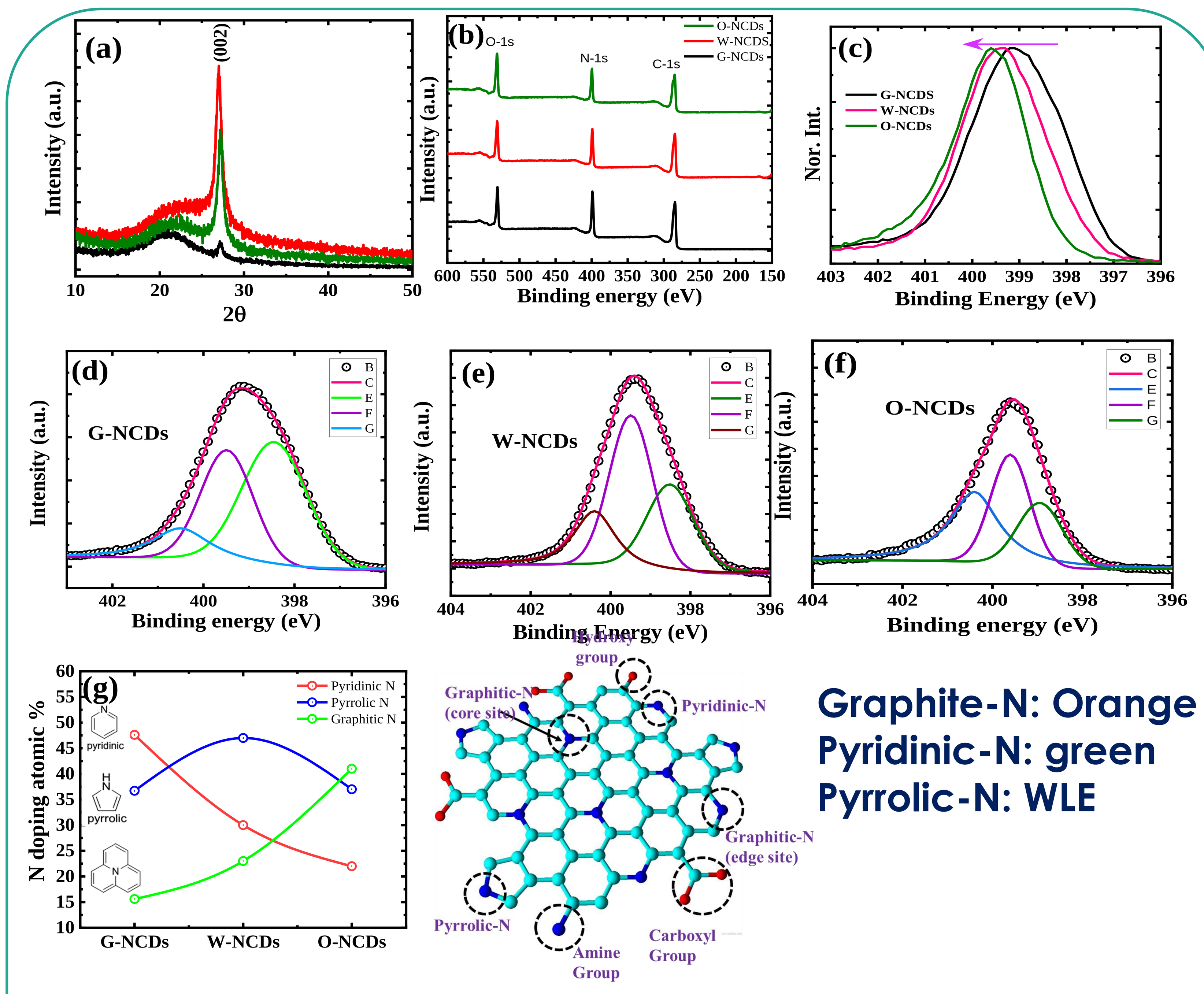


Fig.1 (a and b) XRD and XPS survey spectra of different types of NCDs. (c) Normalized HRXPS spectra of N-1s. (d-f) de-convoluted HRXPS spectra of N-1s of G, W, and O NCDs. The de-convolution N-1s spectra show the different types of N doping centres (pyridinic, pyrrolic, and graphitic) inside the NCD structure. (g) comparison of N doping centres inside the NCD. It clearly displays the tunning of the doping center that control the emitting centers of NCDs. Schematic representation of a NCD structure

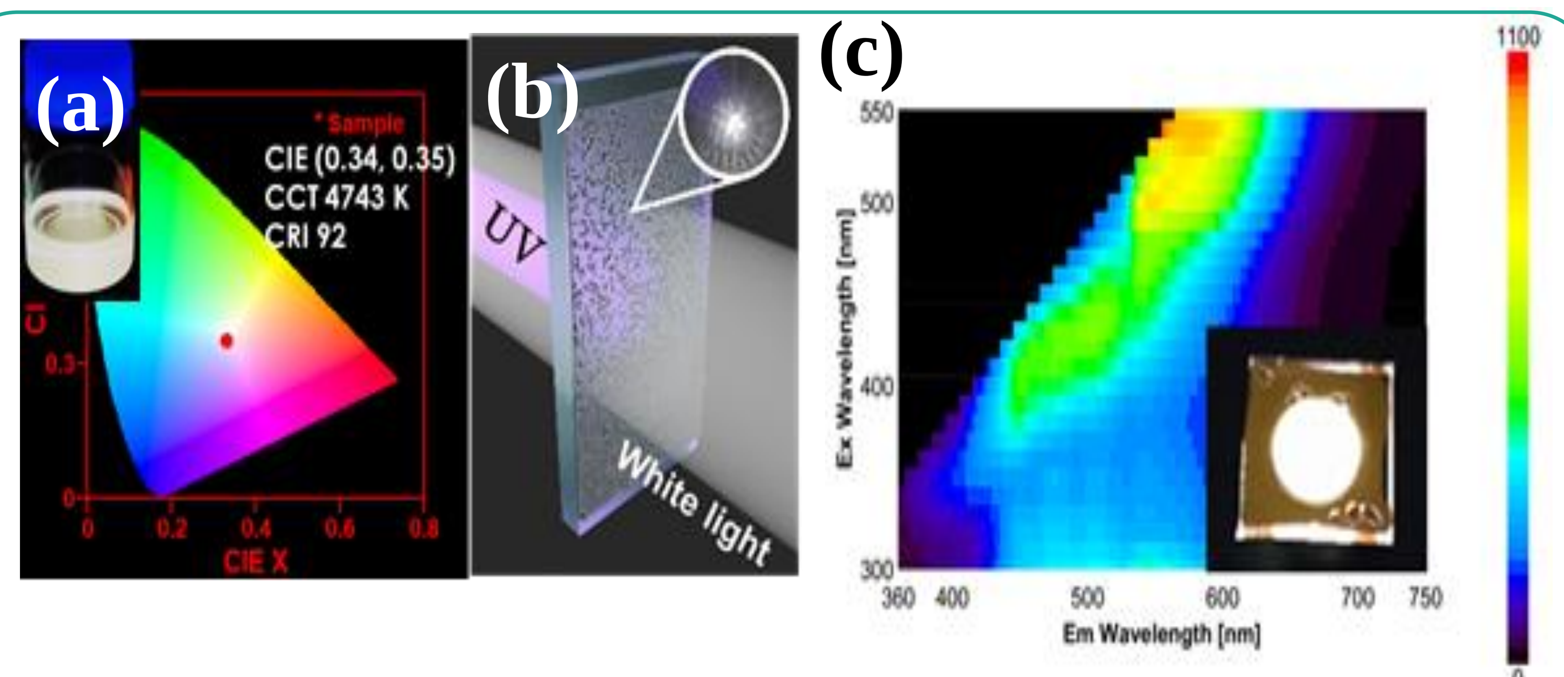


Fig. 4 (a) CIE diagram (Inset shows WLE from NCDs). (b) Demonstration of transparent WLE. (c)2-D excitation-emission spectra. Inset shows solid-state WLE from the NCDs-polymer matrix

Summary and Conclusion

- ✓ The emission property is tuned by the doping centre and surface functional groups leading to multi-colored emission
- ✓ The decrease or increase of the different N doped centres into the CDs leads to the green to orange emission
- ✓ High concentration graphitic N centres leads to orange, pyridinic green emission and pyrrolic N generates to pure WLE
- ✓ By optimizing the pyridinic, pyrrole and graphic N dopant in the NCDs, we achieve direct and pure WLE (CIE: (0.34 and 0.35)) and transparent coating layer with polymer for WLE is demonstrated with high color rendering index (CRI:92) and CIE: (0.34 and 0.35))

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REFERENCES

1. ACS Nano, 11 (2017) 12402
2. Adv Mater, 30 (2018) 1704740.
3. *Angew. Chem. Int. Ed.* 56 (2017) 4170

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