Liu, X., Han, J., Hou, X., Altincicek, F., Oncel, N., Pierce, D., Wu, X. and Xiaojun Zhao, J. One-pot synthesis of graphene quantum dots using humic acid and its application for copper (II) ion detection. *Journal of Materials Science* **56,** 4991–5005 (2021).

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Abstract

A new carbon source, humic acid, has been used in fabricating graphene quantum dots by a facial one-pot hydrothermal reaction. The morphology of the cyan emission graphene quantum dots has been characterized by high-resolution transmission electron microscopy (HRTEM). The result showed well-displayed crystalline with a lattice spacing of 0.286 nm. X-ray photoelectron spectroscopy (XPS) and Fourier-transform infrared spectroscopy (FTIR) have demonstrated the diverse functional groups on GQDs, like carboxylic groups, which will cause significant fluorescence quenching by Cu^{2+} because of the strong chelating interactions. The optical properties of GQDs were characterized by photoluminescence (PL) spectra and ultraviolet–visible (UV–Vis) spectroscopy; it showed that GQDs have an excitation-dependent fluorescence behavior and a large stoke shift with maximum excitation/emission wavelength at 360/470 nm. Furthermore, GQDs showed a good photostability by the kinetic analysis of irradiation for 1500 s and a relatively high quantum yield of 20%, which could be applied in bioimaging. Besides, the selectivity study of metal ions indicates that the GQDs could be used in Cu^{2+} detection. The linear range is from 1 to 40 μM with the limit of detection (LOD) of 0.44 μM. Overall, this work provided a simple method to produce GQDs with low-cost raw material humic acid, which could be also used in Cu^{2+} monitoring in river water.