

Supplementary materials

# Cyan Fluorescent Carbon Quantum Dots with Amino Derivatives for the Visual Detection of Copper (II) Cations in Sea Water

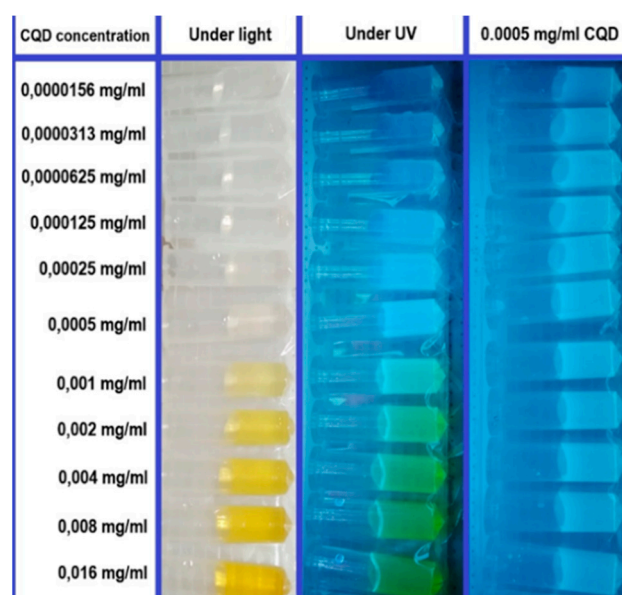
Yakusheva Anastasia <sup>1,\*</sup>, Aly-Eldeen Mohamed <sup>2</sup>, Gusev Alexander <sup>1,3</sup>, Zakharova Olga <sup>1,3</sup> and Denis Kuznetsov <sup>1</sup>

<sup>1</sup> Department of Functional Nanosystems and High-Temperature Materials, National University of Science and Technology MISIS, Leninsky Prospekt 4, 119049 Moscow, Russia; nanosecurity@mail.ru (G.A.); olgazakharova1@mail.ru (Z.O.); dk@misis.ru (D.K.)

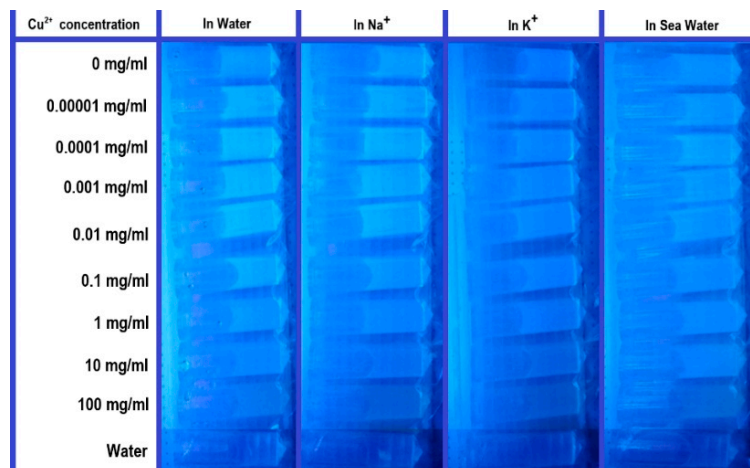
<sup>2</sup> Marine Chemistry Laboratory, National Institute of Oceanography & Fisheries, Kayet-Bey, Al-Anfoushi, 5321430 Alexandria, Egypt; ~~ma.aly-eldeen@niof.sci.eg~~ m\_niof@yahoo.com

<sup>3</sup> Research Institute for Environmental Science and Biotechnology, Derzhavin Tambov State University, 33, Internatsionalnaya str., 392000 Tambov, Russia; nanosecurity@mail.ru (G.A.); olgazakharova1@mail.ru (Z.O.)

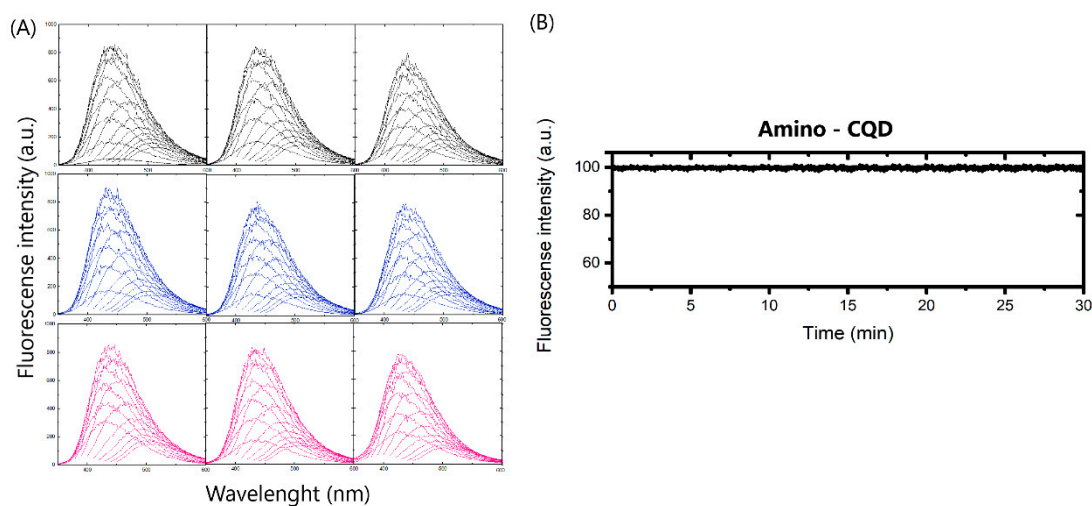
\* Correspondence: yakusheva.as@misis.ru; Tel.: +7-909-669-3081



**Figure S1.** The calibration range of Amino-CQD dispersion under UV irradiation for the visual sensing.



**Figure S2.** The visualization of Amino-CQD quenching effect by  $\text{Cu}^{2+}$  cation under UV light.



**Figure S3** The reproducibility and stability of fluorescence properties.

**Table S1.** The polarization fluorescence analysis of Amino - CQD sample in different ionic solution.

Sample	Polarization of Fluorescence (a.u.)
Amino-CQD	$42.6 \pm 0.2$
Amino-CQD + $\text{Cu}^{2+}$	$181.1 \pm 1.8$
Amino - CQD in NaCl	$46.9 \pm 0.3$
Amino - CQD in KCl	$47.55 \pm 0.2$
Amino - CQD in Sea Water	$49.8 \pm 0.3$
Amino - CQD in NaCl + $\text{Cu}^{2+}$	$183.6 \pm 1.8$
Amino - CQD in KCl + $\text{Cu}^{2+}$	$187.9 \pm 1.8$
Amino - CQD in Sea Water + $\text{Cu}^{2+}$	$193.4 \pm 1.8$

**Table S2.** The lineal fitting results for the fluorescence quenching by  $\text{Cu}^{2+}$  and the calibration curves for visual test.

<b>Stern -Volmer coefficient for the quenching effect in Amino-CQD</b>				
	<b>In Water</b>	<b>In Na+</b>	<b>In K+</b>	<b>In Sea Water</b>
Intercept	0,120 ± 0,003	0,121 ± 0,007	0,121 ± 0,001	0,120 ± 0,007
Slope	0,028 ± 0,001	0,029 ± 0,003	0,028 ± 0,001	0,029 ± 0,003
R <sup>2</sup>	0,992	0,993	0,998	0,996
<b>The coefficient for the calibration curves by Green color reduction in Amino-CQD</b>				
	<b>In Water</b>	<b>In Na+</b>	<b>In K+</b>	<b>In Sea Water</b>
Intercept	134,178 ± 4,432	130,464 ± 3,875	123,964 ± 2,200	124,607 ± 3,658
Slope	-11,214 ± 1,618	-6,857 ± 1,415	-4,940 ± 0,803	-10,928 ± 1,335
R <sup>2</sup>	0,988	0,970	0,977	0,986