Electronic Supplementary Material (ESI) for Analytical Methods.

Supplementary Information for:

Miniaturized chemiluminescence detection system for a microfluidic paper-based analytical device and its application to the determination of chromium (III)

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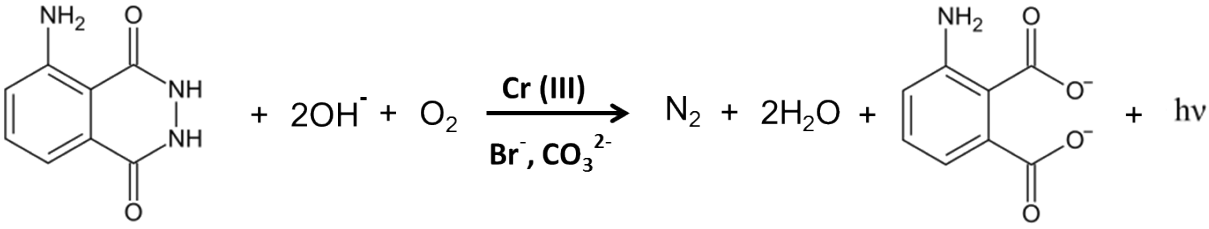
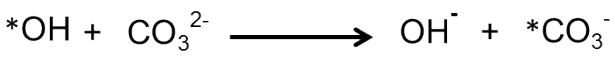
(A)



(B)



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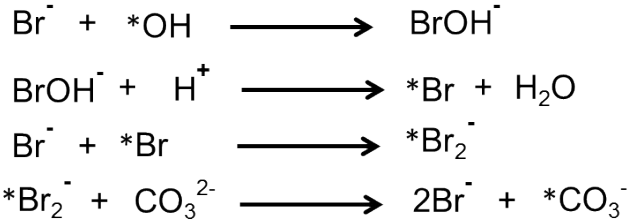

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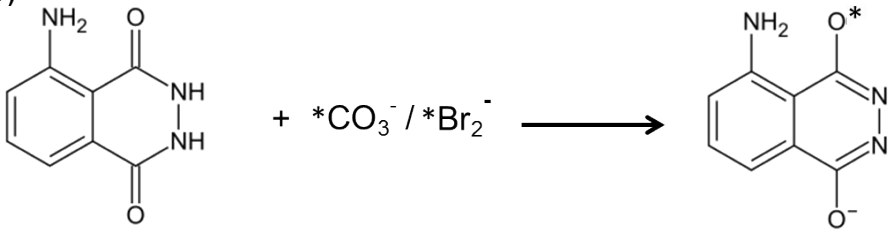

Scheme S1. Reaction scheme of the Cr (III)-catalyzed oxidation of luminol. (A) The Cr (III)-catalyzed oxidation of luminol by hydrogen peroxide in the presence of Br^- and CO_3^{2-} used as enhancers. (B) and (C) Generation of a carbonate radical and a bromide radical via a hydroxyl radical. (D) The reaction between a carbonate radical/bromide radical with luminol to yield a luminol radical.

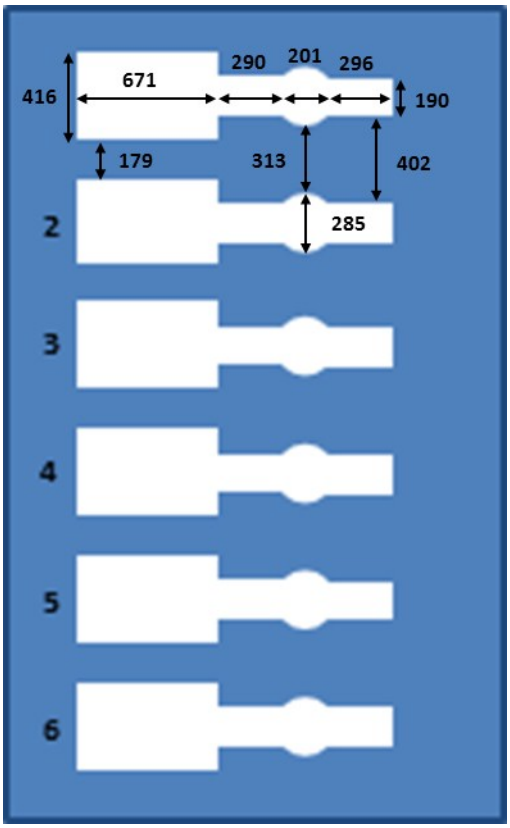

Figure S1. The design of the μPAD (before heating).

The dimensions are indicated in millimeters.

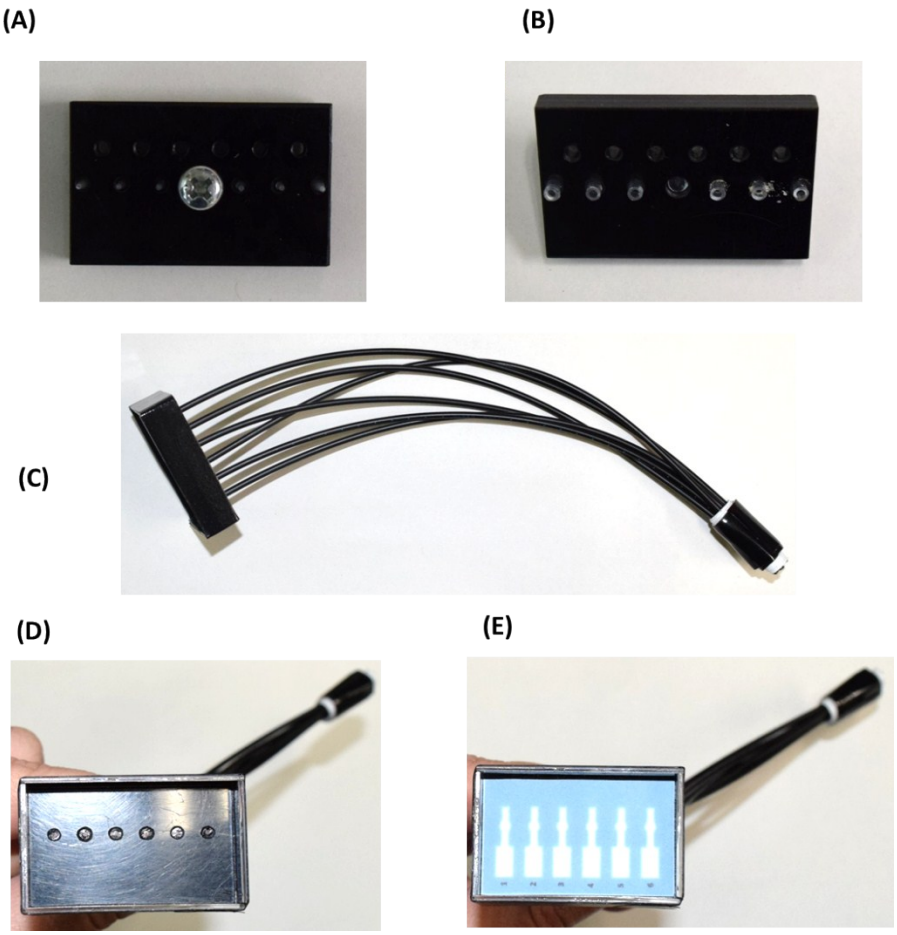

Figure S2. Photos of an acrylic holder's parts.

(A) The cover plate (Top View).

(B) The cover plate (bottom View).

(C) The holder plate after connection with optical fibers (Side View).

(D) The holder plate after connection with optical fibers (Top View).

(E) The holder plate after connection with optical fibers and the μPAD placed on it (Top View).

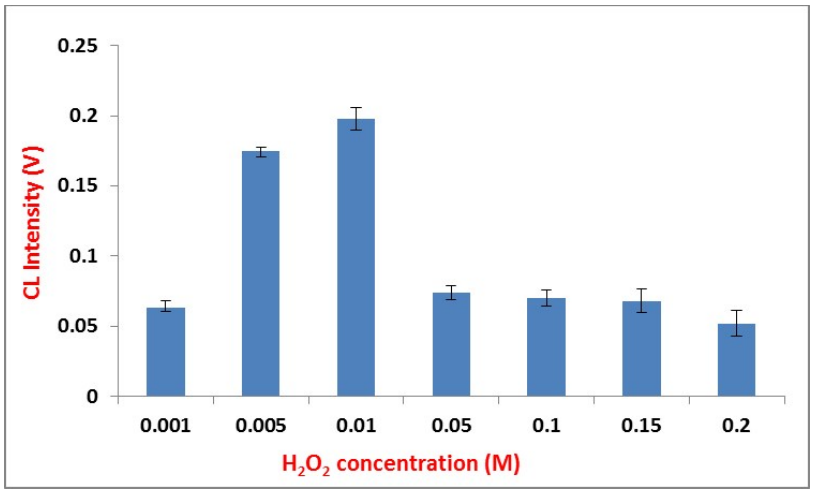

Fig. S3. Effect of hydrogen peroxide concentration on CL intensity.

Cr (III) 3 ppm. CL reaction solution: 10×10^{-4} M luminol, 1.0×10^{-1} M NaBr and 1.0×10^{-2} M EDTA in 5.0×10^{-2} M $NaHCO_3$–Na_2CO_3 buffer, pH of CL reagent 12.1

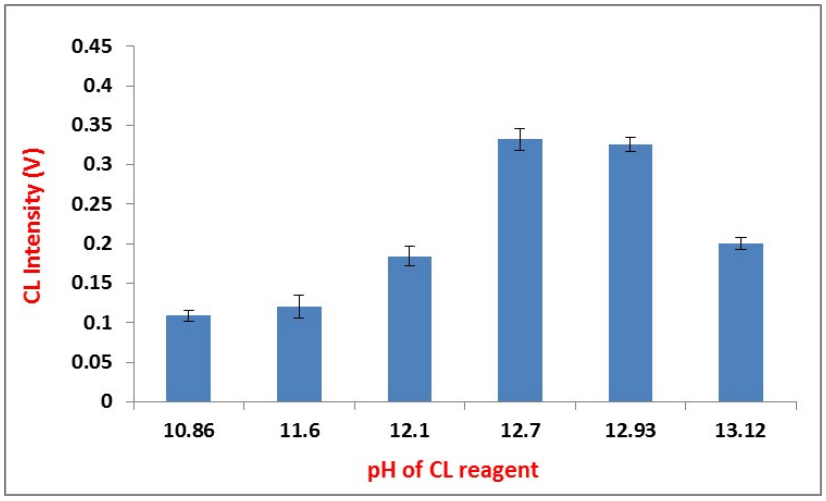

Fig. S4. Effect of pH on CL intensity.

Cr (III) 3 ppm. CL reaction solution: 1.0×10^{-2} M hydrogen peroxide, 10×10^{-4} M luminol, 1.0×10^{-1} M NaBr and 1.0×10^{-2} M EDTA in 5.0×10^{-2} M $NaHCO_3$–Na_2CO_3 buffer.

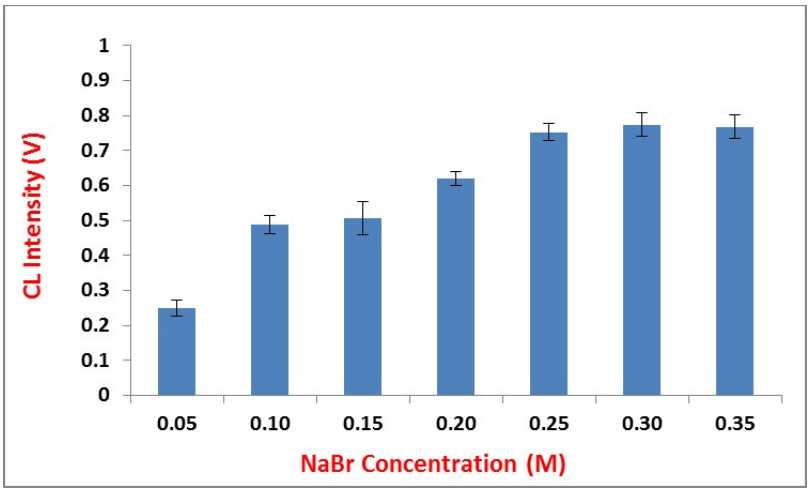

Fig. S5. Effect of sodium bromide concentration on CL intensity.

Cr (III) 3 ppm. CL reaction solution: 1.0×10^{-2} M hydrogen peroxide, 10×10^{-4} M luminol and 1.0×10^{-2} M EDTA in 5.0×10^{-2} M $NaHCO_3$–Na_2CO_3 buffer, pH of CL reagent 12.7.

Table S1. Common concentrations of heavy metals in natural water and the tested concentration in this study.

Interfering species	**Common Concentration in natural water/ ppm**		**Tested Concentration/ ppm**
	River water [a]	**Tap water**	
Cr (III) [1]	0.34×10^{-3}	0.33×10^{-3} [b]	—
Cr (VI) [1]	0.36×10^{-3}	0.13×10^{-3} [b]	5.00 Cr (VI)
Pb [2]	0.48×10^{-3}	0.10×10^{-3} [c]	2.00 Pb (II)
Zn [2]	6.80×10^{-3}	0.80×10^{-3} [c]	10.00 Zn (II)
Cu [2]	1.80×10^{-3}	7.30×10^{-3} [c]	5.00 Cu (II)
Cd [2]	0.09×10^{-3}	0.006×10^{-3} [c]	3.00 Cd (II)
Ni [2]	0.94×10^{-3}	0.75×10^{-3} [c]	10.00 Ni (II)
Mn [2]	5.20×10^{-3}	0.20×10^{-3} [c]	5.00 Mn (II)
Fe [2]	103×10^{-3} [d]	3.7×10^{-3} [c]	5.00 Fe (III)

[a] Zasu River located in Okayama City, Japan.

[b] Tap water from Faculty of Science, Okayama University, Japan.

[c] Tap water from VBL Okayama University, Japan.

[d] River-water reference material for trace metals issued by National Research Council Canada (SLRS-4).

References

1. S. Motomizu, K. Jitmanee and M. Oshima, *Anal. Chim. Acta*, 2003, **499**, 149-155.

2. R. K. Katarina, N. Lenghor and S. Motomizu, *Anal. Sci.*, 2007, **23**, 343-350.