Electronic Supplementary Material (ESI) for RSC Advances

Electronic Supplementary Information

In the top one of Figure S1 the boundaries of $[EDTAH_2]^{2-}$ and Cu^{2+} ions moved in opposite direction through the capillary action, namely, Cu^{2+} moved toward the cathode and $[EDTAH_2]^{2-}$ moved towards the anode. Before the meeting between the boundaries of flow of $[EDTAH_2]^{2-}$ and Cu^{2+}, the whole paper channel was in colorless. It means that blue CB did not form. The electric current in solutions of the paper channel did not breakover although the electric field was applied. The current emerged when the boundaries of $[EDTAH_2]^{2-}$ and Cu^{2+} met. At this moment the chelation reaction took place to generate the blue complex $[Cu\text{-}EDTA]^{2-}$. The moment was chosen as the zero point in the recorded time of the CB migration. The electrokinetic phenomenona, electrophoresis and EOF, occurred in the paper channel. In the middle one of Figure S1 Cu^{2+} moves toward the cathode because of its positive charge, and $[EDTAH_2]^{2-}$ migrates towards the anode due to its negative charge. After $[EDTAH_2]^{2-}$ meeting Cu^{2+} their boundaries were intersected each other, the initial CB turned wider toward both the cathode and the anode. It mainly depended on the directions and magnitudes of the EOF rate and electrophoresis rate in paper channel. In the bottom one of Figure S1 the EOF toward the cathode in paper channel originated from the migration of hydrated cations, which dissociate from carboxy groups of paper fibres as stationary phase in the acidic condition with pH 5.0. The apparent electrophoresis migration distance, x_{ep}, indicates the CB migrates toward the anode due to electrophoresis rate faster than EOF rate, and the apparent EOF migration distance, x_{eof}, of CB migrates toward cathode mainly due to EOF.

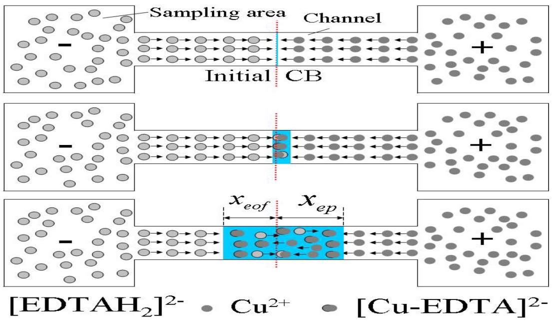
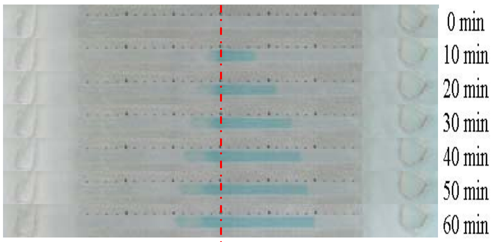


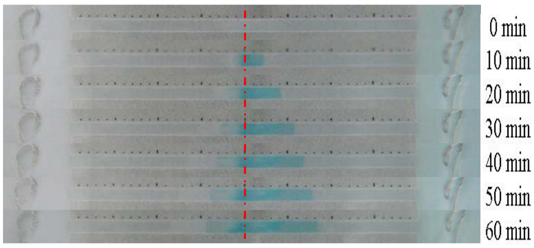
Figure S1: The principle of the MCB between EDTA and Cu^{2+} in the paper channel.
The symbols "+" and "-" indicate the anode and cathode, respectively.

Figure S2 shows the effects of length of paper channel on the CB migrations. The evolution processes of CB were exhibited in Figure S2 (A) and Figure S2 (B) during 0~60min in 6cm and 8cm long paper channels, respectively. The nonlinear curves, $x_{ep} \sim$ t and $x_{eof} \sim$ t from Figure S2 (A), Figure S2 (B) and Figure 2 (C) as 10cm long paper channels were shown in Figure S2 (C). In the nonlinear curves, $x_{ep} \sim$ t, from down to up, the shorter paper channel lengths (e.g. 10, 8, 6cm) are, the higher the electric field strengths are, the faster the CB moving toward the right anode are under the same voltage (100V). In the nonlinear curves, $x_{eof} \sim$ t, from down to up, the shorter paper channel lengths are, the faster the CBs moving toward the left cathode are under the same voltage.

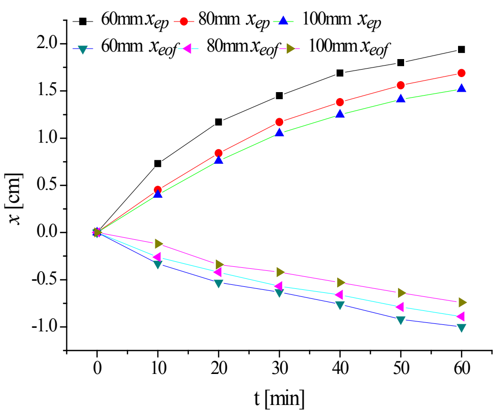
From the images marked 0 min in the Figure S2 (A), Figure S2 (B) and Figure 2(C) the meeting positions of CB between the boundaries of EDTA and Cu^{2+} were 3.03cm, 4.0cm and 5.0cm for 6cm, 8cm and 10cm long channels, respectively. It meant that the meeting positions of the CB were nearly in the centers of the paper channels with different lengths. It indicated that the hydrophilic on the two side of the red dotted very close in the patterned paper channels.



A



B



C

Figure S2: Effect of paper channel length on CB migration.

(A) Paper channel 60 mm×4mm; (B) Paper channel 80mm×4mm; (C) Curves between distance (*x*) and time (t) of MCB with different lengths of paper channels. The MCB images in 100mm×4mm paper channel were shown in the Figure 2(C). The red dotted line indicates the position of the initial formed CB. The size of sampling area is 20mm×20mm. Voltage:100V; Sample: 0.20M EDTA and 0.20M Cu^{2+}. Sampling mode: Simultaneously sampling.