

SUPPLEMENTARY INFORMATION

Basic principles of electrolyte chemistry for microfluidic electrokinetics Part I: Acid-base equilibria and pH buffers

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We here present results of a brief, anecdotal survey of recent microfluidic electrokinesis literature. We survey reported buffer preparation and characteristics of 40 papers with “microfluidics” or “electrokinetics” in the title, abstract, and keywords, and selected articles relevant to experimental microfluidic electrokinetics applications. Presumably, these are studies where electrolyte chemistry is particularly important. We started our survey in 2008 papers and then worked back to previous years. The first column contains our remarks on the buffer preparation or specification, and the second column quotes the relevant buffer information in the paper and provides the reference number.

Table S1 Anecdotal survey of buffer reporting in microfluidic electrokinetic device literature

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| Water as electrolyte (can yield poor control of pH) | “diluted in distilled water” ¹ “buffer liquid milli-Q water with 0.1 wt % SDS” ² |
| Buffering species not reported | “sodium buffer solution of pH 8.5” ³ |
| Strong acid buffer | “buffer solution [79/20/1 (v/v) water/acetonitrile/acetic acid]” ⁴ |
| Salt as electrolyte | “potassium dibasic phosphate (0.4 mM) solution” ⁵ |
| Incorrect procedure | “The pH of this solution was adjusted to a value of 8.0 or 9.0 by adding NaOH. The conductivity of this solution was adjusted to a value between 25 and 100 S/cm by adding K ₂ HPO ₄ ” ⁶ |
| Buffer concentration on the order of carbonate concentration from the atmosphere | “0.1 mM phosphate buffer saline (PBS), pH 7.4” ⁷ “buffer containing 0.25 mM tris-(hydroxy)aminomethane hydrochloride and 1.92 mM glycine at pH 8.8” ⁸ “potassium dibasic phosphate (0.4 mM) solution” ⁵ |
| No buffer concentration reported | “tris-ethylenediamine tetraacetic acid buffer solution with a pH of 8.0” ⁹ “phosphate buffer at pH 10.3 with 2mM NaCl” ¹⁰ |
| No pH reported | “a buffer containing 10 mM sodium tetraborate. A second buffer, 20 mM <i>N</i> -[2-hydroxyethyl] piperazine- <i>N</i> -[2-ethanesulfonic acid] (HEPES) and 1 mM sodium tetraborate” ¹¹ “25mMsodium carbonate/bicarbonate buffer diluted in DI water” ¹² “10 ⁻³ M Tris-HCl buffer” ¹³ |
| No titrant reported | “5 mmol/L HEPES solution” ¹⁴ “5.0 mM borate buffer solution with different pH values of 8.6, 9.2, and 10.0” ¹⁵ “10 mM sodium borate (pH 9.2)” ¹⁶ “10 ⁻³ M sodium borate (pH 8.5)” ¹⁷ “MES (pH 6.00 20 mM)” ¹⁸ |
| No titrant and no pH reported | “HEPES solution (1 M) from Calbiochem was used as the buffer stock and was diluted with DI water to a concentration of 50 mM” ¹⁹ |
| pH not in buffering range | “30mM TES buffer (pH 5.79)” ²⁰ “10 mM phosphate buffer at pH 2, 3, 4, 5, 6, 7, 9 and 11” ²¹ “sodium carbonate/bicarbonate buffer (...) pH = 9.0” ²² |
| Used conventional buffer recipe (prone to ambiguity) | “1x TBE buffer, pH 8.2” ²³ “1x TTE (50 mM Tris/50 mM TAPS/2 mM EDTA)” ²³ “1X and 0.5X TBE buffers, pH 8.3” ²⁴ |

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| | “20 mM TES (pH 7.0)” ²⁵ |
| Titrate borate | “10mM Na2B4O7 buffer, adjusted to pH 9.5 using 1 M NaOH solution” ²⁶ |
| Fully reported concentrations (although non-conventional reporting of ion density vs. total buffer concentrations) | “buffer of 6 mM Tris+, 2 mMCl” ²⁷ “6 mM Tris+, 2 mM TAPS” ²⁷ |
| Reported concentration, titrant, and pH | “40 mM Tris/HCl buffer (pH 8.8)” ²⁸ “Ten millimolars PBS consisting of Na+ and K+ was prepared with H2PO4 and Na2HPO4 (1:1). Ten millimolars PBS consisting of only Na+ was prepared with Na2HPO4 and NaH2PO4 (1:1). Ten millimolars PBS consisting of only K+ was prepared with K2HPO4 and KH2PO4 (1:1). Ten millimolars PBS consisting of only Li+ was prepared with 30mM LiOH solution and neutralized with H3PO4. The pH value of all the PBS is equal to 7.0” ²⁹ “The pH 8.0 phosphate stock solutions (200 mM) were prepared by mixing monobasic and dibasic phosphate at the volume ratio of 1/9” ³⁰ “20 mM MES/His buffer (pH 6)” ³¹ “0.5 mol/L Tris-borate buffer, pH 8.3” ³² “20 mM sodium acetate buffer, pH 4.3” ³³ “buffer is 25 mM tris-HCl (...) titrated to pH 7.5” ³⁴ MES/His buffer (20mM each, pH 6.1) ³⁵ TE buffer (10 mM Tris-HCl, 1 mM EDTA, pH 8.0) ³⁶ “BGE composed of 30 mmol/L caffeic acid, whose pH was adjusted to 8.0 with Tris.” ³⁷ “5 mM acetate buffer (pH 5.0)” ³⁸ Table 1 describes species concentration and pH ³⁹ “All buffer solutions contained 5.0 mM TRIS and 5.0 mM Tris-HCl (pH 8.3)” ⁴⁰ |

Notes and references

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