## **Supplementary Information**

## Three-Dimensional Micropillar Electrode Array-Based Microfluidic Sensor for Sensitive and Stable Voltametric Detection of Phosphate

## Xinxin Li<sup>a,1</sup>, Wangyufei Zhao<sup>a,1</sup>, Yang Li<sup>a</sup>, Huizhong Han<sup>a</sup>, Gulsim Kulsharova<sup>c</sup>, Emad Uddin<sup>d</sup>,

## Jingmin Li<sup>a,b\*</sup> and Chong Liu<sup>a,b\*</sup>

<sup>a</sup> School of Mechanical Engineering, Dalian University of Technology, Dalian, Liaoning Province, China

<sup>b</sup> Key Laboratory for Micro/Nano Technology and System of Liaoning Province, Dalian University of Technology,

Dalian, Liaoning Province, China

<sup>c</sup> Nazarbayev University, Astana, Kazakhstan

<sup>d</sup> School of Mechanical & Manufacturing Engineering, National University of Sciences and Technology, Islamabad, Pakistan

<sup>1</sup> These authors contributed equally to this work.

\* Correspondence, E-mail: chongl@dlut.edu.cn; jingminl@dlut.edu.cn

The purpose of a finite element mesh is to characterise the geometry and the solution domain. Increasing the number of finite cells usually improves the accuracy of the solution, but it also leads to an increase in memory as well as a longer computation time. Therefore, when using the 'free triangular mesh' for meshing, only the electrode domains of the microcylindrical array electrodes are finely dissected, while the other domains are relatively coarsely dissected, and the complete mesh consists of 30283 domain cells, 4154 boundary cells, and 440 edge cells. The results are shown in Fig. S1.





Fig. S1 Finite element mesh generation diagram.





Fig. S3 Cyclic voltammograms of micro-column electrodes with different heights

radius/µm	start/µm	stop/µm	step/µm
5	66	74	2
10	116	124	2
15	156	164	2

Tab. S1 Parametric scan par	ameter setting	for array s	spacing
-----------------------------	----------------	-------------	---------

According to the fabrication method described in Section 2.4, the electrode morphology diagrams with cylindrical radius of 15  $\mu$  m and inter-cylindrical spacings of 130 $\mu$ m, 160 $\mu$ m, 175 $\mu$ m and 190 $\mu$ m were fabricated as follows:



Fig. S4 Surface morphology of electrodes at different pitches (a) d=130um; (b) d=160um; (c) d=175um; (d) d=190um



Fig. S5 The response currents of a three-dimensional cylindrical array electrode with a radius of 15µm tested by the timing current method at different intervals