

## Supporting Information

### **Industrially Compatible Manufacturing Process of Wash-Durable Antimicrobial Textiles by using Cuprous Oxide-Polymer Composites**

Hung-Tung Chen,<sup>†</sup> Ming-Cai Huang,<sup>‡</sup> Yi-Ying Chiang,<sup>‡</sup> Yong Chang,<sup>‡</sup> and Chia-Ching Wu<sup>\*,†</sup>

<sup>†</sup>Department of Applied Science, National Taitung University, 369, Sec. 2, University Rd.,  
Taitung City 95092, Taiwan

<sup>‡</sup>Department of Technology Application, DAZZEON Technology, 6F, No. 337, Sec. 1, Dunhua  
S. Rd., Da'an District, Taipei City 10685, Taiwan

Corresponding author: [ccwu@nttu.edu.tw](mailto:ccwu@nttu.edu.tw)

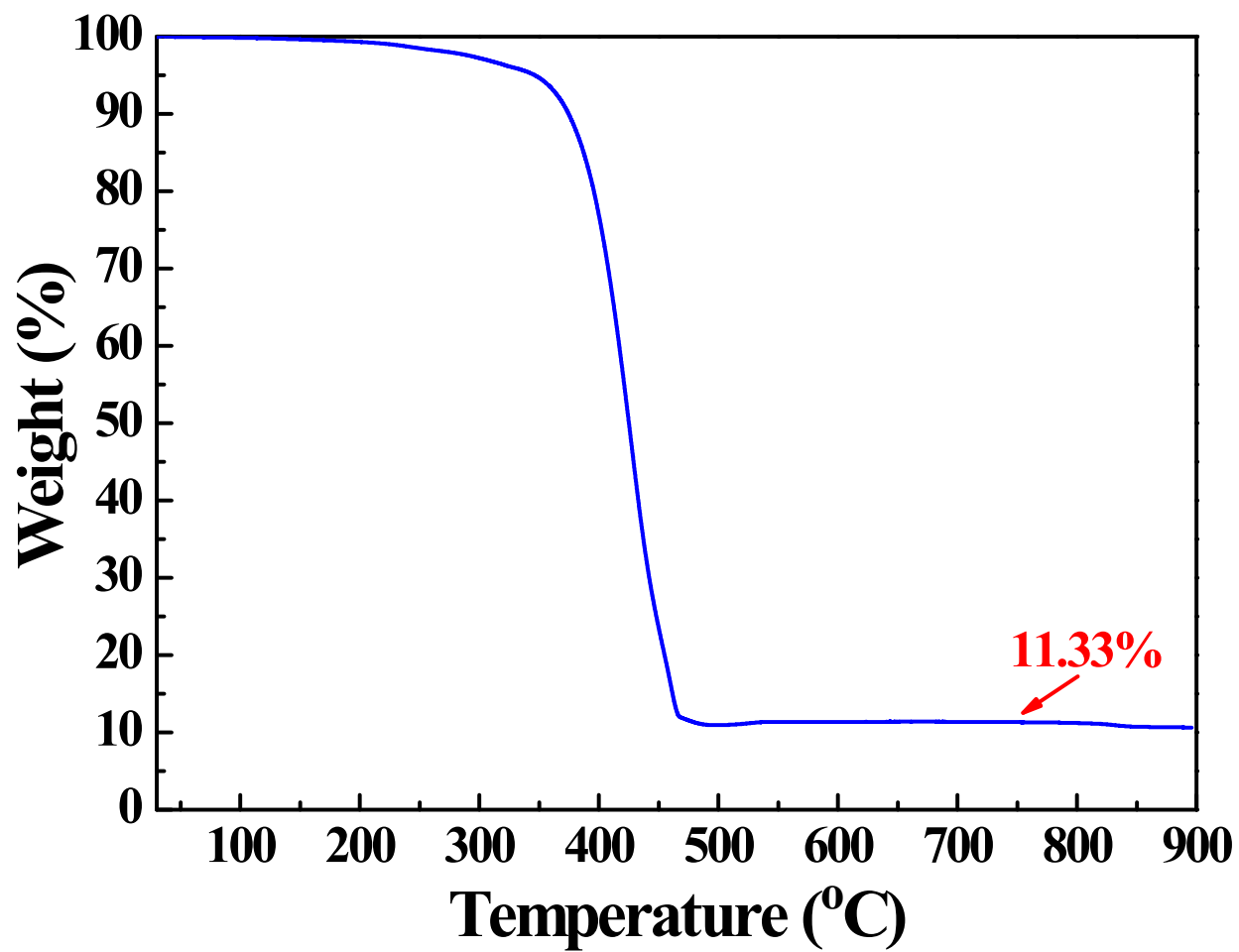


Figure S1. Thermogravimetric analysis (TGA) curves of the Cu<sub>2</sub>O NP-embedded PP masterbatches.



Figure S2. Digital images of (a) a facemask made of Cu<sub>2</sub>O NP-PP meltblown nonwoven fabrics using Cu<sub>2</sub>O NP-embedded PP masterbatches as raw material. (b) Cu<sub>2</sub>O NP-embedded PET masterbatches that can be used to fabricate Cu<sub>2</sub>O NP-PET meltblown nonwoven fabrics as demonstrated in (c).

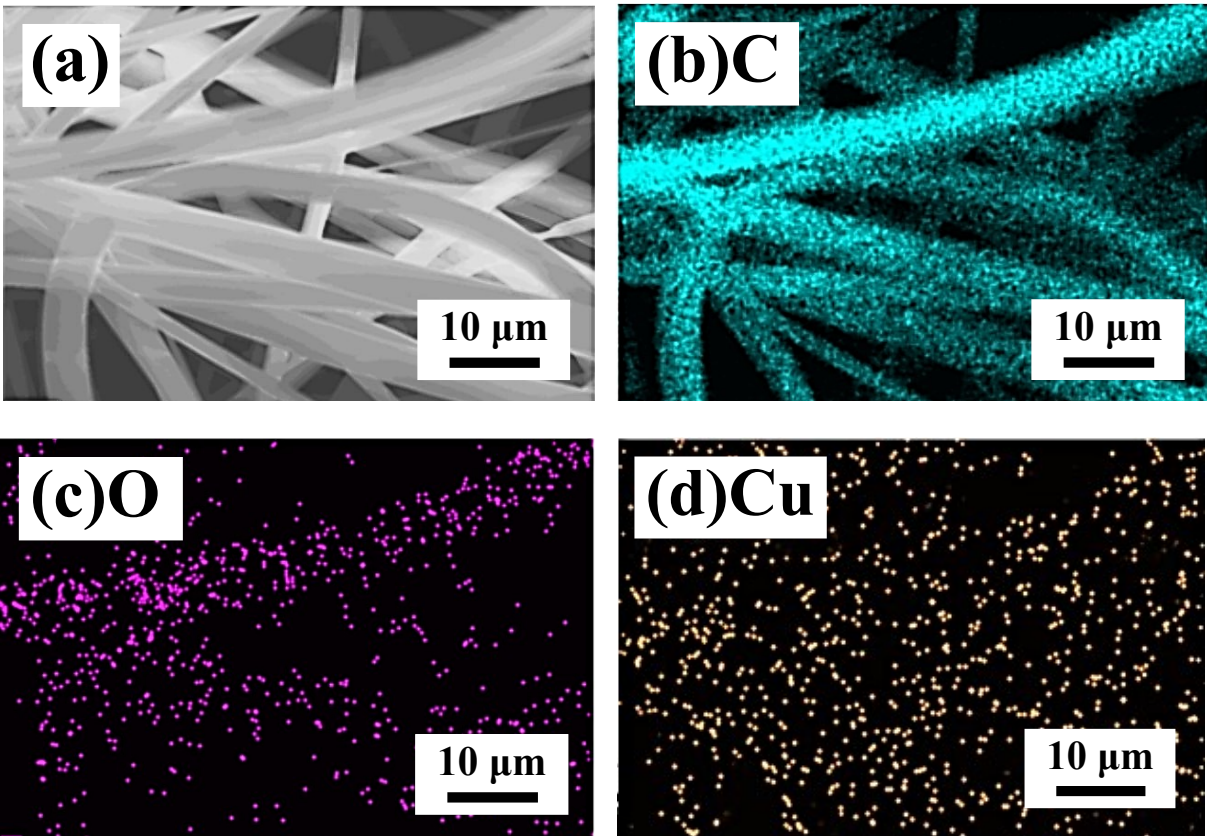


Figure S3. SEM image and elemental mapping of the  $\text{Cu}_2\text{O}$  NP-PP meltblown nonwoven fabrics. (a)  $\text{Cu}_2\text{O}$  NP-PP meltblown nonwoven fabrics, (b) C element, (c) O element and (d) Cu element.

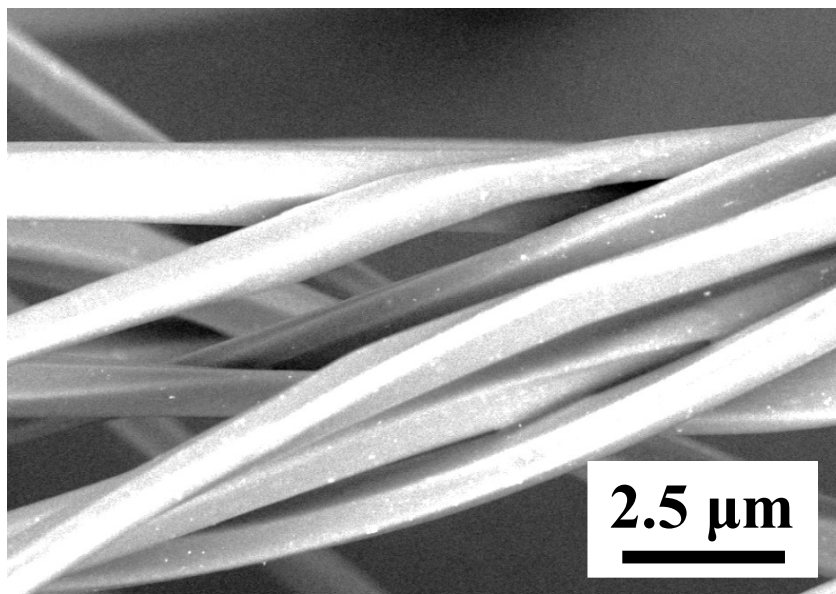


Figure S4. SEM image of the  $\text{Cu}_2\text{O}$  NP-PET meltblown nonwoven fabrics.

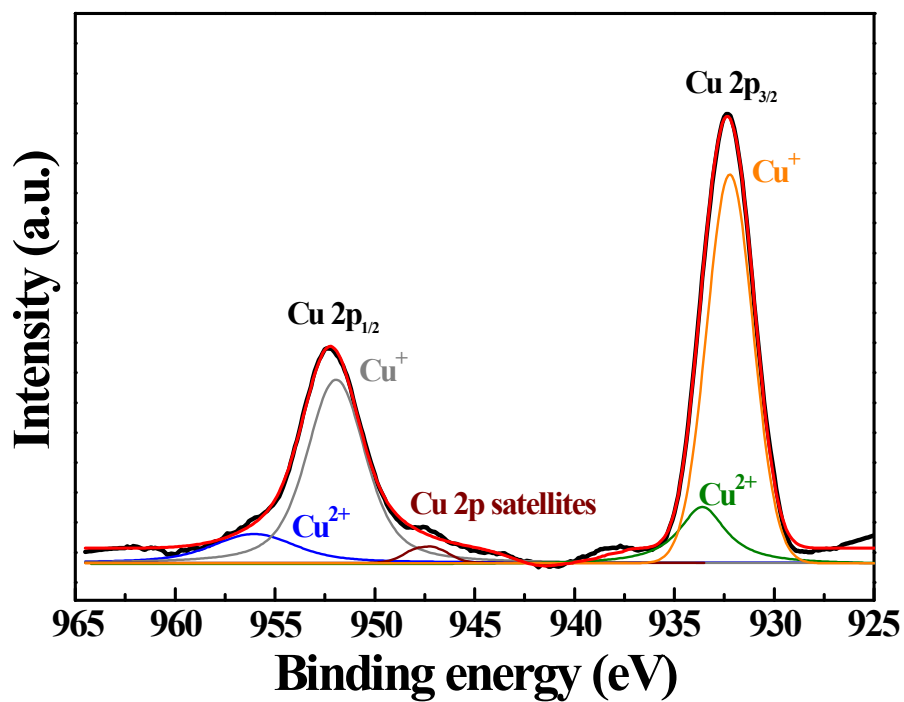



Figure S5. The Cu<sub>2</sub>O NP-embedded PP masterbatches measured using high resolution Cu 2p XPS after standing times of 12 months lay aside in the air.

Table S1 Color coordinates of the Cu<sub>2</sub>O NP-embedded PP antimicrobial textiles.

<b>Sample</b>	<b>L*</b>	<b>a*</b>	<b>b*</b>	<b>K/s</b>
	66.12	1.92	18.2	0.190

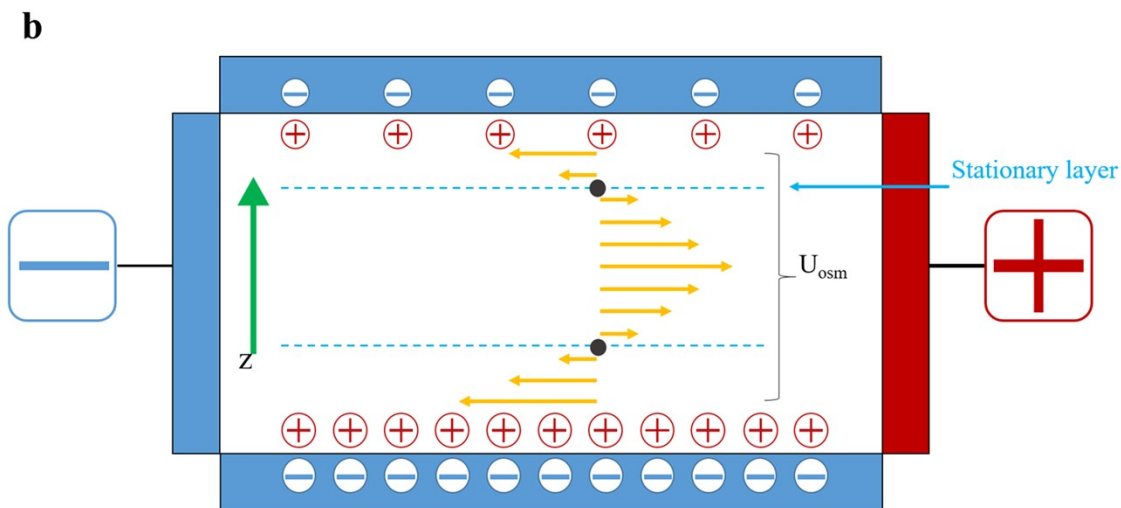
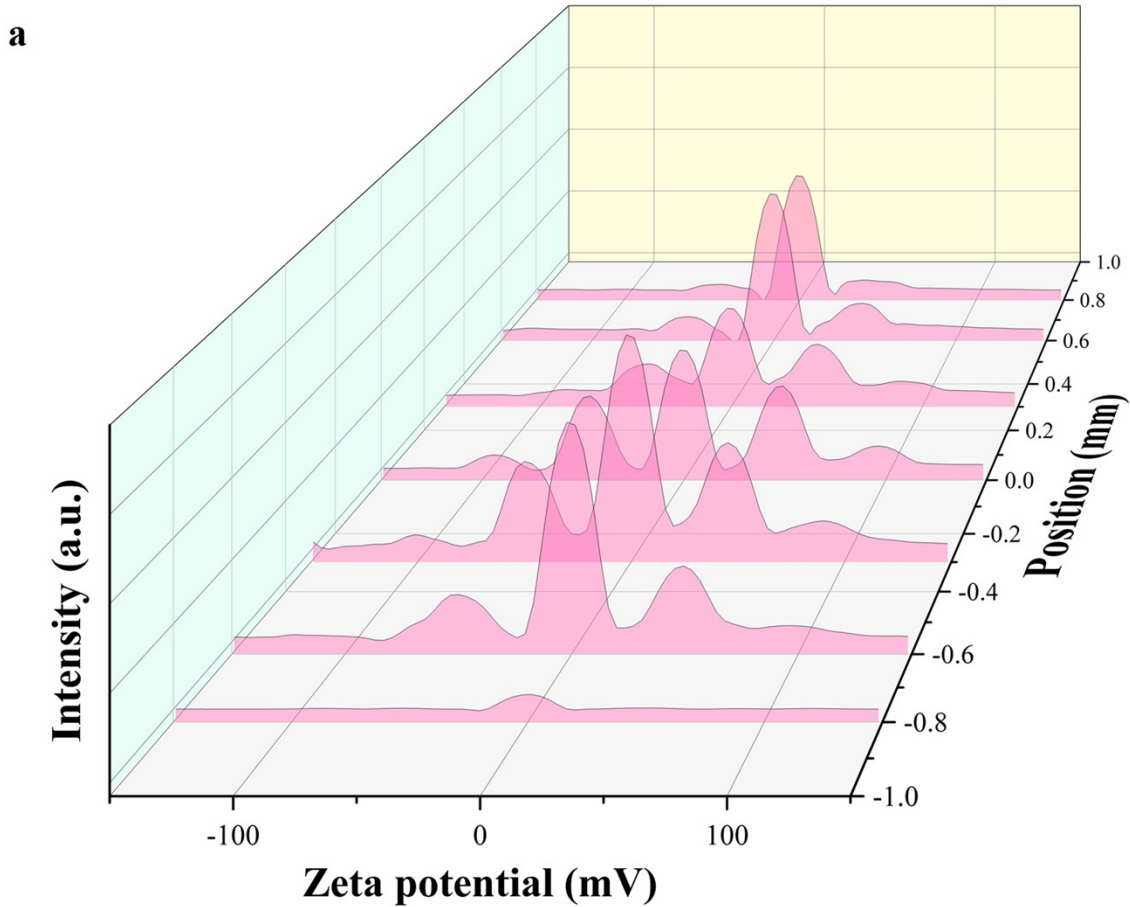


Figure S6. (a) Zeta potential measurements of a  $\text{Cu}_2\text{O}$  NP-PP meltblown nonwoven fabrics. Measurement is designed to collect data of electrophoretic mobility at several positions in the cell where the mobility is not influenced by electroosmotic flow, as shown in (b).



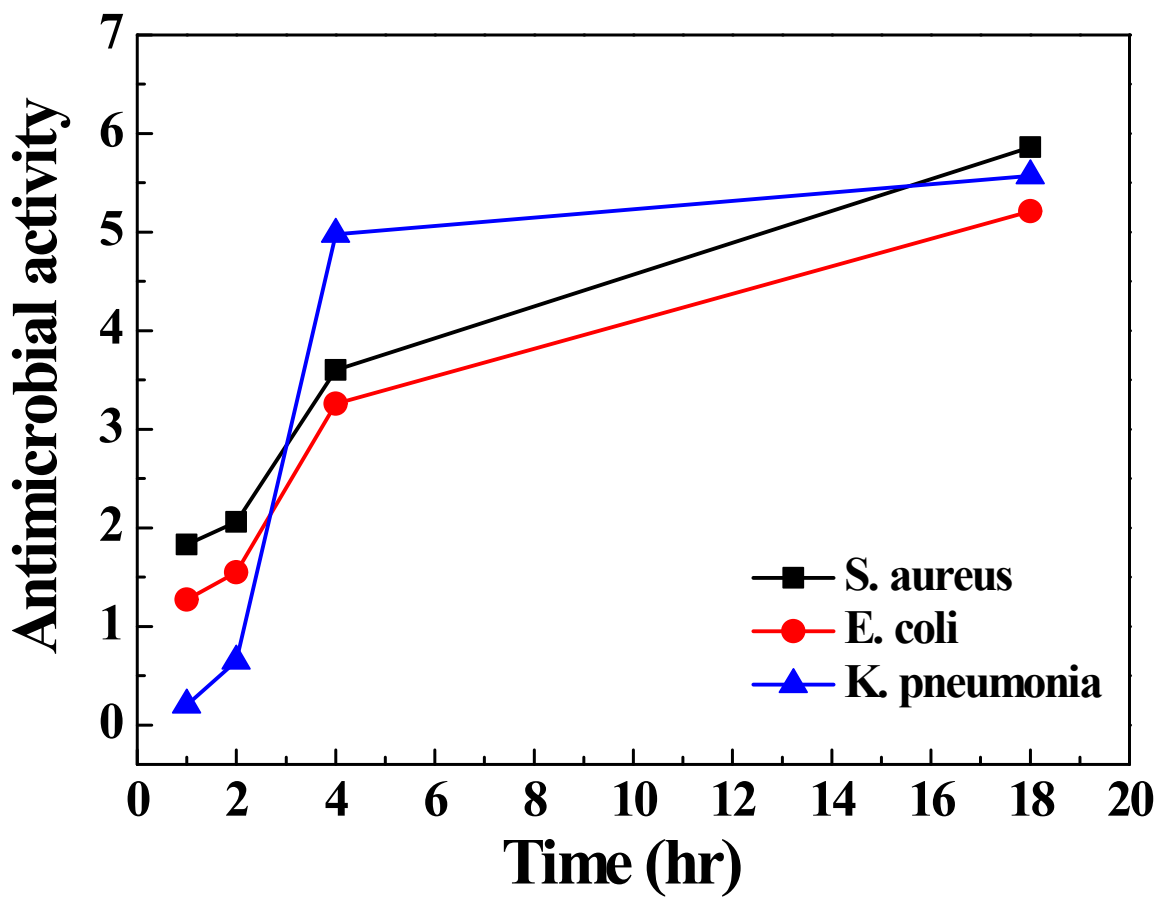


Figure S7. Antimicrobial activity of  $\text{Cu}_2\text{O}$  NP-PP meltblown nonwoven fabrics to *S. aureus*, *E. coli*, and *K. pneumonia* as a function of contact time.

Table S2. The freshly prepared Cu<sub>2</sub>O NP-PP melt-blown nonwoven fabric's antibacterial activity and sample standard deviation (SSD), based on five samples after 18-24 hours of contact time.

<b>Bacteria species</b>	<b>Antimicrobial activity</b>	<b>SSD</b>
<i>P. aeruginosa (ATCC 10145)</i>	5.24, 5.28, 5.22, 5.31, 5.25	0.0354
<i>E. coli (ATCC 8739)</i>	5.21, 5.18, 5.22, 5.21, 5.20	0.0152
MRSA ( <i>ATCC 33591</i> )	5.33, 5.32, 5.37, 5.33, 5.29	0.0286
<i>K. pneumonia (ATCC 4352)</i>	5.57, 5.54, 5.61, 5.57, 5.55	0.0269
<i>S. aureus (ATCC 6538P)</i>	5.86, 5.87, 5.84, 5.85, 5.88	0.0158
<i>C. albicans (ATCC 10231)</i>	5.38, 5.43, 5.33, 5.37, 5.35	0.0377

Table S3. The antibacterial activity and sample standard deviation (SSD) of the Cu<sub>2</sub>O NP-PP melt-blown nonwoven fabric after 12 months of storage, based on five samples after 18-24 hours of contact time.

<b>Bacteria species</b>	<b>Antimicrobial activity</b>	<b>SSD</b>
<i>P. aeruginosa (ATCC 10145)</i>	5.19, 5.17, 5.19, 5.16, 5.18	0.0130
<i>E. coli (ATCC 8739)</i>	5.15, 5.11, 5.13, 5.14, 5.14	0.0151
MRSA ( <i>ATCC 33591</i> )	5.27, 5.27, 5.22, 5.24, 5.25	0.0212
<i>K. pneumonia (ATCC 4352)</i>	5.51, 5.49, 5.51, 5.50, 5.48	0.0131
<i>S. aureus (ATCC 6538P)</i>	5.79, 5.73, 5.71, 5.77, 5.75	0.0316
<i>C. albicans (ATCC 10231)</i>	5.32, 5.28, 5.31, 5.32, 5.30	0.0167

Table S4. Washing resistance of antimicrobial activities and sample standard deviation (SSD) of Cu<sub>2</sub>O NP-PET meltblown nonwoven fabrics.

Bacteria species	Antimicrobial activity			
	Before washes	SSD	After washes	SSD
<i>P. aeruginosa (ATCC 10145)</i>	5.77, 5.79, 5.75, 5.77, 5.76	0.0147	5.43, 5.41, 5.45, 5.42, 5.45	0.0178
<i>E. coli (ATCC 8739)</i>	5.77, 5.74, 5.72, 5.75, 5.77	0.0212	5.55, 5.58, 5.53, 5.57, 5.52	0.0254
MRSA ( <i>ATCC 33591</i> )	5.83, 5.85, 5.88, 5.85, 5.86	0.0181	5.59, 5.56, 5.58, 5.55, 5.57	0.0158
<i>K. pneumonia (ATCC 4352)</i>	5.86, 5.84, 5.88, 5.86, 5.85	0.0148	5.55, 5.55, 5.57, 5.54, 5.56	0.01141
<i>S. aureus (ATCC 6538P)</i>	5.62, 5.69, 5.66, 5.65, 5.68	0.02738	5.42, 5.41, 5.45, 5.43, 5.45	0.01788