Supplementary information

Superior Antibacterial Activity of Gallium based Liquid Metal Due to Ga^{3+} Induced Intracellular ROS Generation

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1. The composition of the surfaces according to the XPS peak intensity

Through normalizing data of Ga 3d and In 3d, the percent of Ga, Ga_2O, Ga_2O_3, In and In_2O_3 was calculated as following[1]:

$$C_x = \frac{I_x / S_x}{\sum_i I_i / S_i} \quad \text{(S1)}$$

Where C_x is a certain atom fraction of one constituent in the sample, I_x is peak area corresponding to the constituent, S_x is the instrument-specific atomic sensitivity factor of the corresponding element.

Sample	Percent of Ga (%)	Percent of Ga_2O (%)	Percent of Ga_2O_3 (%)	Percent of In (%)	Percent of In_2O_3 (%)
Raw EGaIn film	60.9	16.99	18.17	2.57	1.33
EGaIn film treated by 1 h UV exposure	46.61	24.17	22.56	2.70	0.96

Table S1. Quantitative analysis of Samples through XPS

2. The anti-bacterial test on the PTFE membrane separated EGaIn piece

We put a 0.4 μm pore PTFE membrane on the EGaIn piece (see Figure. 1d) and performed the same anti-bacterial test as that for EGaIn piece. The PVC film with PTFE coating was used as the control group. The results showed that the CFUs of *E. coli* cells on the EGaIn pieces with and without PTFE membrane were both zero after 12 h incubation. For the *S. aureus* cells, the number of viable cells on the PTFE-covered EGaIn piece became zero after 20 h incubation, which was also consistent with the results of uncovered EGaIn piece.

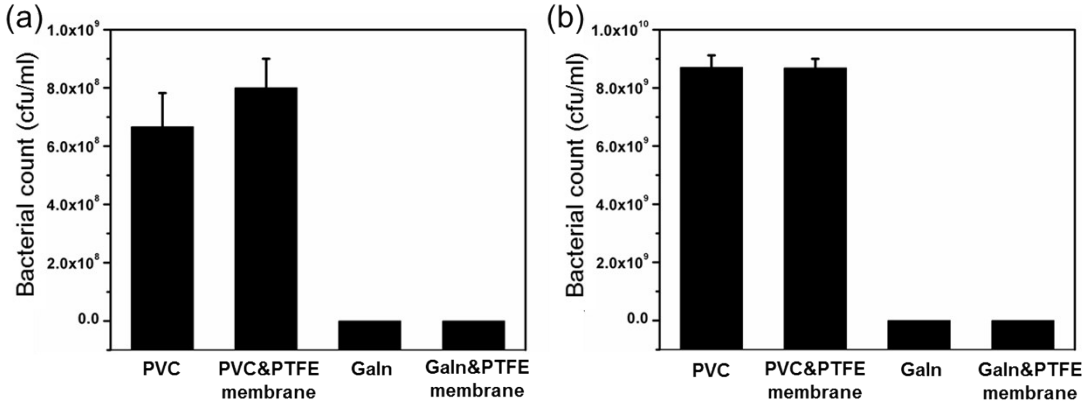

Figure S1. The number of viable (a) *E. coli* cells and (b) *S. aureus* cells on the PVC and EGaIn pieces with and without PTFE membrane covering.

3. The growth curve of bacterial cells on pure Ga film

The fabrication process of the pure Ga film was the same as that of the EGaIn film, except the material poured into the container of the airbrush was pure Ga. The experimental process of the anti-bacterial tests was also the same as that of the EGaIn film. The bacteria-killing kinetics of the pure Ga film against the bacterial strains are shown in Figure. S2(a) (*E. coli*) and Figure. S2(b) (*S. aureus*).

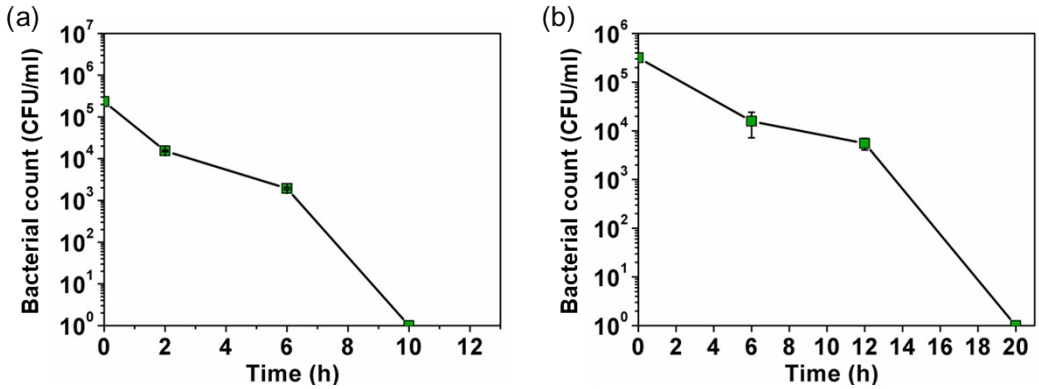

Figure S2. The growth curve of (a) *E. coli* cells and (b) *S. aureus* cells on pure Ga film. The count numbers were shown on a LOG scale with a base of 10.

Table S2. The viable count of bacterial cells on EGaIn film and pure Ga film

E. coli cells			*S. aureus* cells		
Time(h)	EGaIn	Pure Ga	Time(h)	EGaIn	Pure Ga

0	270000±27886	262400±22604	0	316000±31134	316000±17240
2	32733±2017	15333±353	6	19000±2076	15733±4939
6	1400±276	1933±67	12	1367±344	5533±867
10	0	0	20	0	0

4. The concentration of Fe in the medium

The concentrations of Fe in the medium before and after EGaIn film exposed were measured by using ICP-AES and shown in Figure. S3.

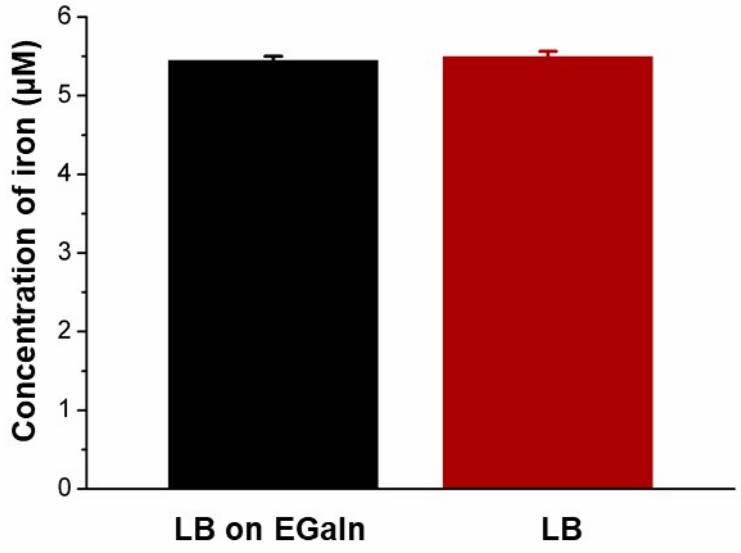

Figure S3. The concentration of Fe in the LB medium exposed to EGaIn for 4 h and in the LB medium. There is no significant difference between the two groups.

5. The viable count of bacteria in different concentrations of $FeCl_3$ solution on PVC

We counted the viable bacteria in 0, 50, 200 μM of $FeCl_3$ solution after 4 h incubation on PVC and the results were shown in figure S4. For both *E. coli* and *S. aureus* cells, there is no significant difference between 0 and 50 μM groups. When the concentration of $FeCl_3$ increased to 200 μM, the number of viable cells silightly

increased but still in the same order of magnitude (10^7).

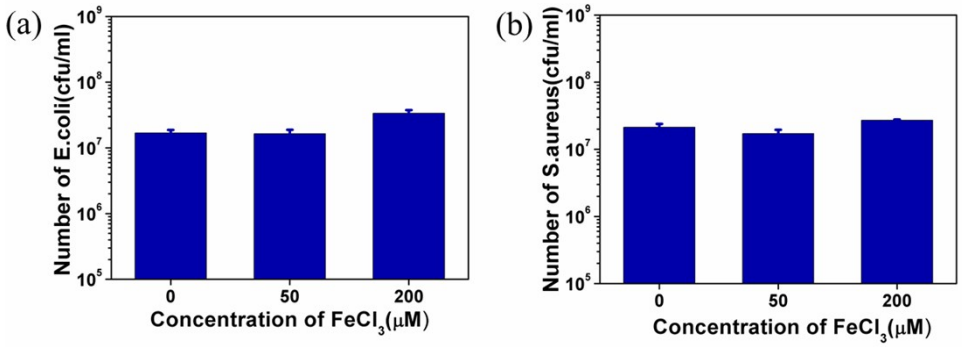

Figure S4. The viable count of (a) *E. coli* cells and (b) *S. aureus* cells in different concentrations of FeCl3 solution on PVC after 4 h incubation.

6. Antibacterial test reports by Testing Center of Antimicrobial Materials, TIPC, CAS

Test Center of Antimicrobial Materials
Technical Institute of Physics and Chemistry, Chinese Academy of Sciences

Report Number: L15145 Page 1 of 1

Sample Name *	Gallium-Indium alloy	Test Sort	Sample entrusted test
Sample Number	L15145	Client *	Technical Institute of Physics and Chemistry, Chinese Academy of Sciences
Sample Amount	12		
Brand *	/	Address *	No. 29, Zhongguancun east road, Haidian district, Beijing, 100190
Type *	/		
Batch No. *	/	Receive date	May 25, 2015
Manufactory *	Technical Institute of Physics and Chemistry, Chinese Academy of Sciences	Test Period	May 25, 2015 - June 1, 2015
		Test Item	Value of antibacterial activity Antibacterial rate

Sample Description: The samples are gallium-indium alloy coatings. The samples and the blanks are separately made to 50mm×50mm by the standards.

Test Method: JIS Z 2801: 2012 Antimicrobial products—Test for antimicrobial activity and efficacy

Test Bacteria: *Escherichia coli* ATCC 25922
Staphylococcus aureus ATCC 6538

Test Result:

Item / Name	Average of the viable cell (CFU/cm^2)		Value of antibacterial activity (R)	Antibacterial rate (%)
	0h	After 24h		
	Escherichia coli			
Blank	1.3×10^4	9.2×10^5	--	--
Sample	--	1.9×10^2	3.7	>99
	Staphylococcus aureus			
Blank	2.0×10^4	5.0×10^5	--	--
Sample	--	<1.3	>5.6	>99

June 25, 2015

References:

1. D. C, Wagner., M. W, Riggs., E. L, Davis. and F. J, Moulder, *Handbook of X-ray Photoelectron Spectroscopy*, Perkin-Elmer corporation, Eden Prairie, Minnesota, USA., 1979.