

Supplemental Material

Modulated Collective Motions and Condensation of Bacteria

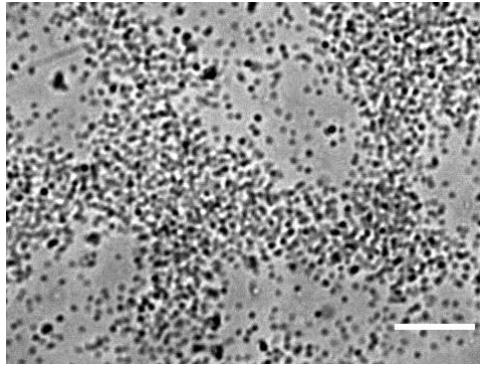
Mei-Mei Bao(鲍美美)^{1†}, Isaiah Eze Igwe^{2†}, Kang Chen(陈康)^{1*}, and Tian-Hui

Zhang(张天辉)^{1*}

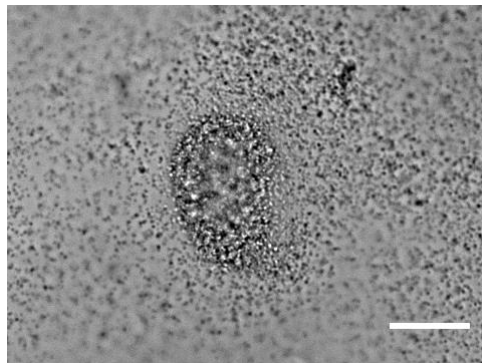
¹*Center for Soft Condensed Matter Physics and Interdisciplinary Research & School of Physical Science and Technology, Soochow University, Suzhou 215006, China*

²*Department of Physics, Federal University Dutsin-Ma, Katsina State 821101, Nigeria*

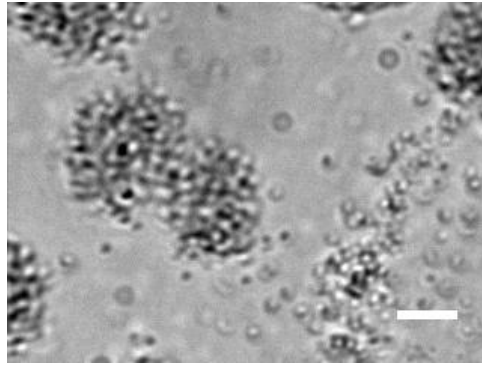
Description of movies



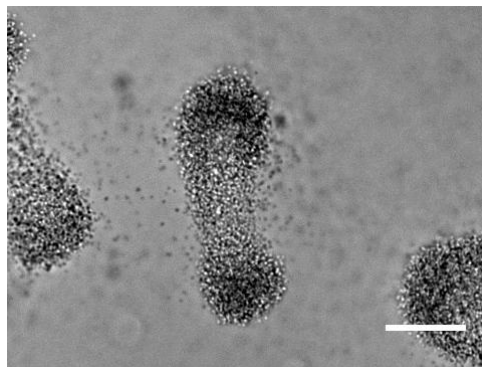
Movie 1. Condensed phase at $E=0.03$ V/ μm , $f=20$ Hz. At frequencies between 1.0~100 Hz, the system separates into two coexisting phases: a dense phase and a sparse phase. The field of view is 120×90 μm^2 . The rate of movie is 10 frames per second. Scale bar: 20 μm .



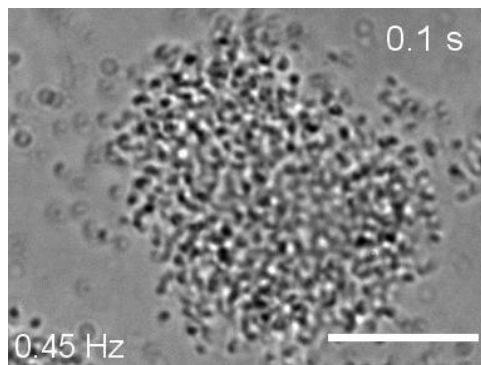
Movie 2. Formation of clusters at $E=0.035$ V/ μm , $f=0.2$ Hz. The field of view is 120×90 μm^2 . The rate of movie is 10 frames per second. Scale bar: 20 μm .



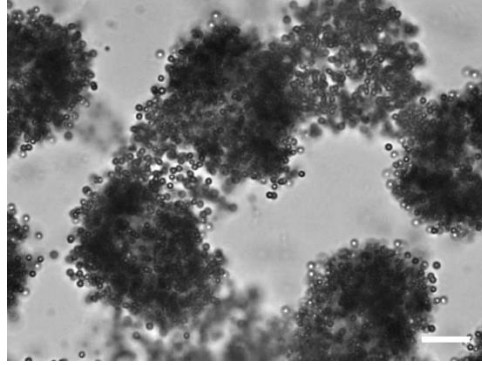
Movie 3. Merging of clusters at $E=0.035 \text{ V}/\mu\text{m}$, $f=0.5 \text{ Hz}$. The field of view is $80 \times 60 \mu\text{m}^2$. The rate of movie is 10 frames per second. Scale bar: $20 \mu\text{m}$.



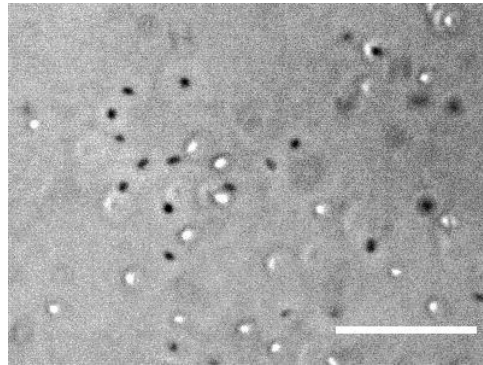
Movie 4. Splitting of clusters at $E=0.035 \text{ V}/\mu\text{m}$, $f=0.2 \text{ Hz}$. The field of view is $120 \times 90 \mu\text{m}^2$. The rate of movie is 10 frames per second. Scale bar: $20 \mu\text{m}$.



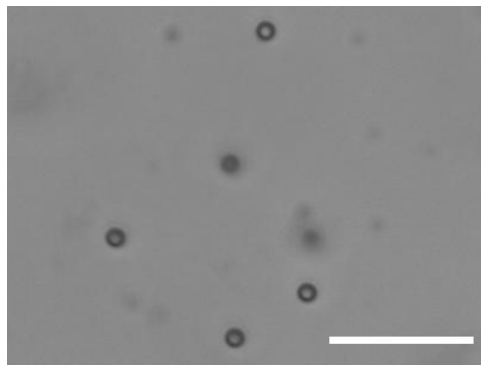
Movie 5. Steady clusters oscillating and no ordered structure at $E=0.035 \text{ V}/\mu\text{m}$, $f=0.45 \text{ Hz}$. The field of view is $96 \times 72 \mu\text{m}^2$. The rate of movie is 10 frames per second. Scale bar: $20 \mu\text{m}$.



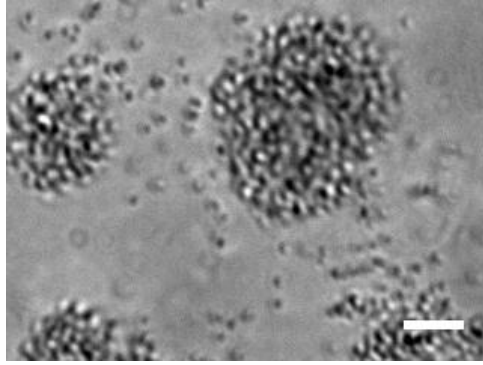
Movie 6. Colloidal clusters with merging and splitting at $E=0.035 \text{ V}/\mu\text{m}$, $f=0.3 \text{ Hz}$. The field of view is $200 \times 150 \mu\text{m}^2$. The rate of movie is 10 frames per second. Scale bar: $20 \mu\text{m}$.



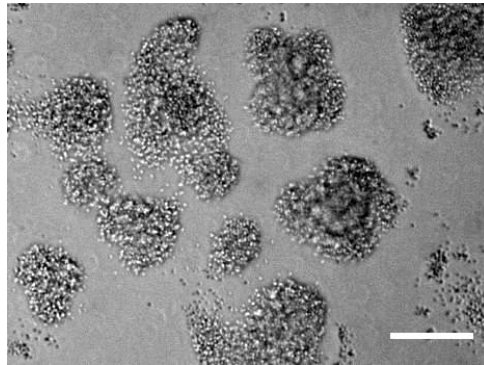
Movie 7. The motion of individual bacteria at $E=0.03 \text{ V}/\mu\text{m}$, $f=0.3 \text{ Hz}$. The field of view is $100 \times 75 \mu\text{m}^2$. The rate of movie is 10 frames per second. Scale bar: $20 \mu\text{m}$.



Movie 8. The motion of individual colloid particle at $E=0.03 \text{ V}/\mu\text{m}$, $f=0.3 \text{ Hz}$. The field of view is $100 \times 75 \mu\text{m}^2$. The rate of movie is 10 frames per second. Scale bar: $20 \mu\text{m}$.



Movie 9. Growth and splitting at $E=0.035 \text{ V}/\mu\text{m}$, $f=0.5 \text{ Hz}$. The field of view is $80 \times 60 \mu\text{m}^2$. The rate of movie is 10 frames per second. Scale bar: $20 \mu\text{m}$.



Movie 10. Controlled splitting when frequency is tuned from 0.3 Hz directly to 0.6 Hz, $E=0.035 \text{ V}/\mu\text{m}$. The field of view is $116 \times 87 \mu\text{m}^2$. The rate of movie is 10 frames per second. Scale bar: $20 \mu\text{m}$.