Unveiling Janus Nanoparticle-Bacteria Interactions Towards Nano-antibiotics Development

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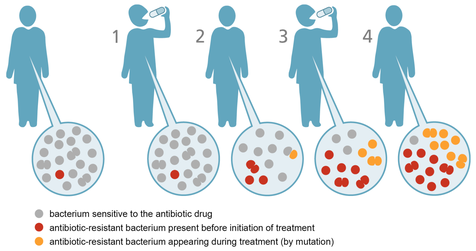
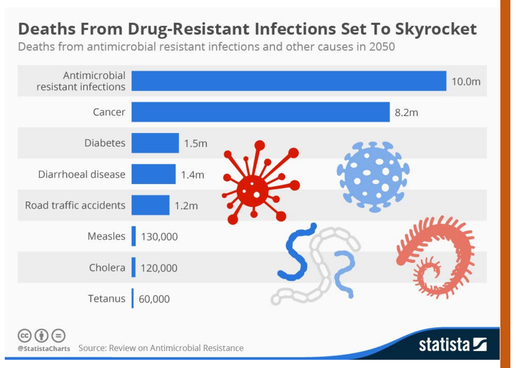
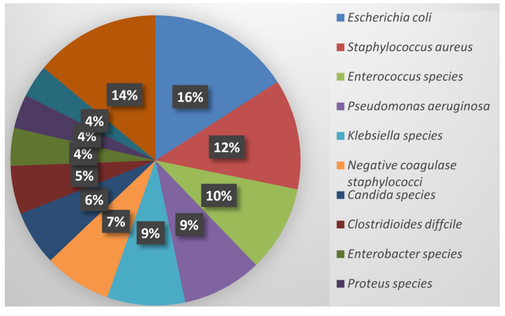
Emergence of Drug Resistance





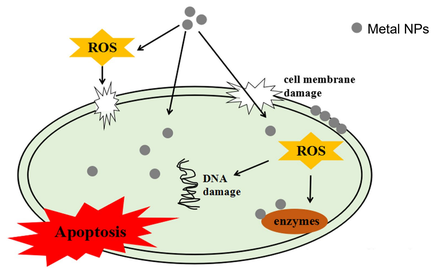
Most common isolated bacteria responsible for Multidrug Resistance



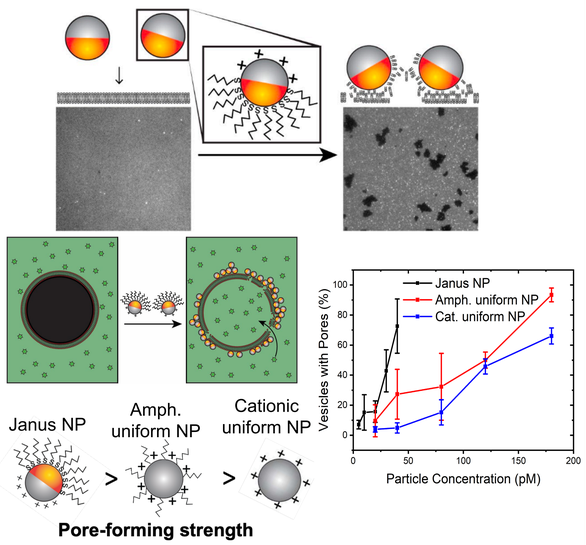
***E. coli* is the most common cause of nosocomial or hospital acquired infections**

Amphiphilic Janus Nanoparticles as Potential Antibacterial Agents for Drug Resistant Bacteria

Antimicrobial mechanism of NPs on bacteria



Previous NSF-supported work: Amphiphilic "two-faced" Janus NPs (JPs) rupture lipid membranes more potently than uniform particles



- J. Wiemann, et al. *Nanoscale* **2020**,12, 20326-20336
- K. lee, et al. *ACS Nano* **2018**, 12, 4, 3646-3657
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- K. lee. *Soft Matter* **2019**, 15, 2373-80
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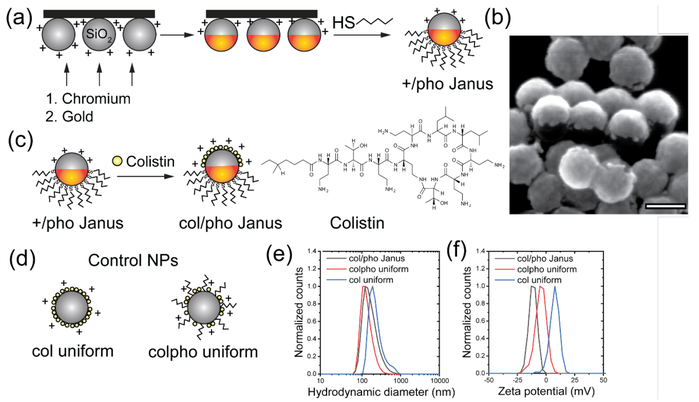
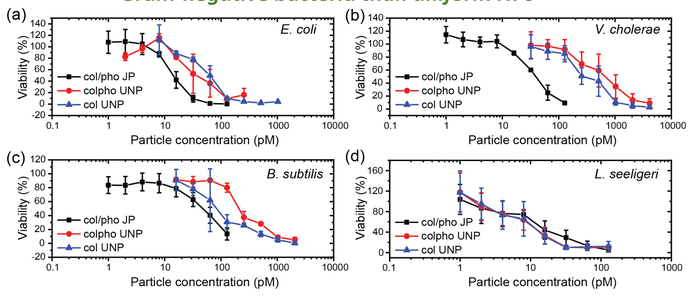
Fabrication of amphiphilic Janus NPs and control NPs.



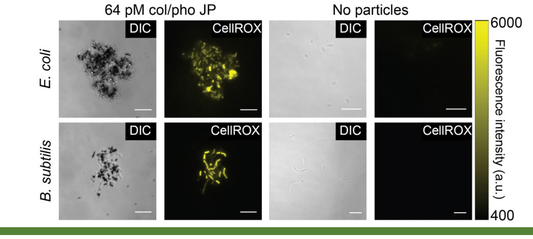
Janus NPs are more effective against both Gram-positive and Gram-negative bacteria than uniform NPs



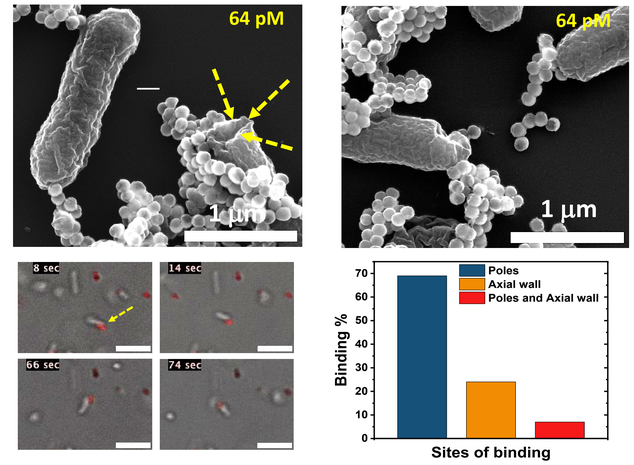
(e)

EC50 (pM)	col/pho JP	colpho UNP	col UNP
E. coli	10 ± 2	41 ± 5	37 ± 9
V. cholerae	34 ± 4	600 ± 200	420 ± 80
B. subtilis	47 ± 8	208 ± 8	70 ± 20
L. seeligeri	18 ± 7	9 ± 1	9 ± 1

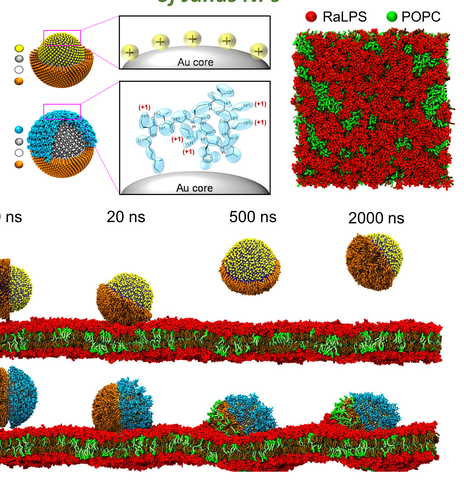
Janus NPs induce Reactive Oxygen Species (ROS) in bacteria



Janus NPs preferentially bind to bacterial pole and rupture the bacterial cell envelope



Simulation: Polycationic ligands enhance antibacterial activity of Janus NPs



- **J. Wiemann, et al. *ACS Applied Nano Materials, 2023***
- ***Yu, Wiemann, Bhattacharyya. patent application, PCT/US2023/062203.***

Future Directions

- Expand the antimicrobial activity of JPs on biofilm of Gram-positive bacteria.
- Investigate the antibacterial efficacy mechanism of amphiphilic JPs against *E. coli* with diverse cell wall chemistries

Conclusions

- JPs were demonstrated as efficient antibiotics than UPs for both species of bacteria tested.
- JPs reduce the viability of both Gram-negative and Gram-positive bacteria at lower conc. than UPs.
- JPs induce pores on the cell wall at low conc. than UPs

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