

Highlights

- Multifunctional Au nanostars (NSs) were designed and synthesized successfully.
- Au NSs had good photothermal effect and high SERS activity.
- Distribution of electromagnetic field of Au NSs was studied using FDTD method.
- Au NSs can achieve the efficient inactivation of *Staphylococcus aureus*.
- Detection limit of MB and BR by Au NSs was as low as 10^{-7} and 10^{-6} M, respectively.