Plasmonic Nanosensors for Optical Monitoring of Labile Zinc Inside Metastatic Cells

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Abstract

Triple-negative breast cancer (TNBC) accounts for 20% of breast cancer and tends to metastasize to the brain. For this reason, TNBC tumors have a higher rate of distant recurrence and with lower 5-year survival rate than other breast cancer. Zinc, an essential trace element and its aberrations involves closely with cancer progression and cellular dysfunction. In our work, we focus on sensing the potential relevance between zinc and TNBC metastasis. Based on surface enhanced Raman spectra (SERS) methodologies, zinc nano-sensor was designed. We chose the 2,2': 6'-2''-Terpyridine-4'-Thiol (TPY) as the sensing molecular and modified gold/silica nanocapsules (NCs) with TPY (NCs@TPY) to detect different amount of zinc in different metastatic TNBC cells. The tpy group can form stable complexes with Zn^{2+} and produced the relative SERS sensitive peak at 1034 cm^{-1}. For chemoselective SERS analysis, zinc was determined by the ratiometric increase of a Raman peak at 1034 cm^{-1}, relative to the main peak at 1021cm^{-1}. Our work compared the different concentrations of zinc in MDA-MB-231 cell, brain metastasis model BrM_2 cell and lung metastasis model LM_2 cell, we found out Zn^{2+} concentration increased a lot inside the metastatic cells than the other cancer cell under same amount of Zn^{2+} incubated conditions. Our sensor with the LOD of $10^{-11.72}$ M is much lower than the Zn^{2+} standard methods by Zinquin. Herein a highly sensitive monitoring nanosensor for in situ zinc analysis inside single cell is presented.

References

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Figures

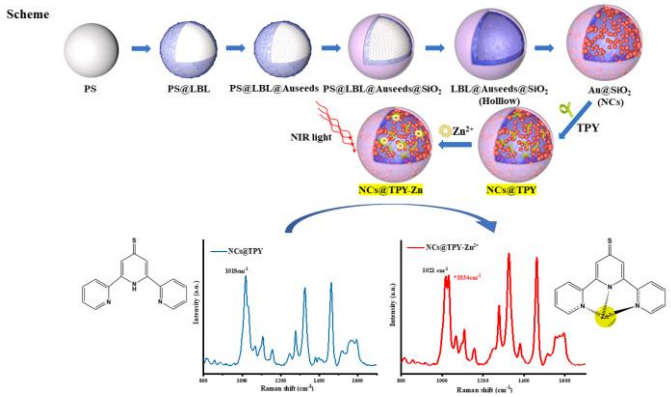

Figure 1. the scheme of zinc nanosensor. Based on the TPY characteristic molecule Raman signal, changes in intracellular zinc ion concentration are detected. After it combined with free zinc ions, the new Raman peak at 1034 cm^{-1} appeared, served 1034 cm^{-1} as the sensitive peak.