A Localized Surface Plasmon Resonance (LSPR)-based, simple, receptor-free and regeneratable Hg^{2+} detection system

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A simple, receptor-free and regeneratable Hg^{2+} sensor, which utilizes localized surface plasmon resonance (LSPR) red-shifts of a gold nanorod (GNR), has been developed. Precipitation induced by coordination of Hg^{2+} to citrate alters the local refractive index (RI) around the GNR surface on glass slide, promoting a red-shift in its LSPR absorption peak. This phenomenon is used to design a sensor that enables quantitative detection of Hg^{2+} in the 1 nM to 1 mM concentration range with good linearity (0.9507 correlation coefficient) and limit of detection (LOD) is reached to 0.38 nM. A high selectivity of this sensor for Hg^{2+} is demonstrated by the specific LSPR red-shift of 27.67 nm promoted by Hg^{2+} in comparison to those caused by other metal ions. In addition, the reusability of the new sensor chip is shown by its successful reuse eight-times following successive washing/precipitation steps. Lastly, the sensor displays excellent recoveries in spiking test with real water samples, such as tap water, lake and river. The simple combination of precipitation of Hg^{2+}-citrate complex and the LSPR red-shift has led to the design of a novel sensing strategy for Hg^{2+} detection.