Colorimetric label-free nanosensor for improved sensitive lead detection in water utilizing unmodified AuNP: Insight into rational design of Pb2+zyme

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Abstract

Water pollution accidents caused by the lead contamination, such as Flint water crisis in the United States, strongly pushed the public to concern the safety of the drinking water distribution system. As a prerequisite, the routine monitoring of lead in water is highly required and demands for an efficient, sensitive, cost-effective, and reliable lead detection methods. This study reports a label-free colorimetric nanosensor using unmodified gold nanoparticles (AuNPs) as indicators to enable rapid and ultrasensitive detection of lead in environmental water. The 8-17 DNAzyme was truncated in this study to facilitate the detachment of ssDNA fragments after the substrate cleavage upon Pb2+ presence. The detached fragments got adsorbed over AuNPs and protected their aggregation against induced salt concentration. As expected, more Pb2+ would result in a stronger color change from blue to pink. The established sensing principle achieved a sensitive limit of detection (LOD) of Pb2+ as 0.2 nM with a linear working range of two orders of magnitude from 0.5 nM to 5.0 nM. The selectivity of nanosensor was demonstrated by evaluating against interfering metal ions. The developed nanosensor can serve as a substitute for rapid analysis and monitoring trace lead levels under the drinking water distribution system and even other environmental water samples.

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