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A fluorescent “on-off-on” probe for sensitive detection of ATP based on ATP displacing DNA from nanoceria

Fangfang Li^a, Xuan Hu^a, Fengyi Wang^a, Baozhan Zheng^a, Juan Du^{a*}, Dan Xiao^{a,b*}

^aCollege of Chemistry, Sichuan University, 29 Wangjiang Road, Chengdu 610064, China.

^bCollege of Chemical Engineering, Sichuan University, 29 Wangjiang Road, Chengdu 610065, China

dujuanchem@scu.edu.cn;

xiaodan@scu.edu.cn

Abstract

A simple, rapid, and ultrasensitive fluorescence strategy for adenosine triphosphate (ATP) detection was developed by using a FAM (carboxyfluorescein) labeled DNA (FAM-DNA). In this strategy, highly fluorescent FAM-DNA was used as a probe, and nanoceria (CeO₂ NPs) acted as an efficient quencher. FAM-DNA attached to the surface of nanoceria through the coordination between the phosphate group of DNA and NP surface, which induced complete quenching in the FAM-DNA fluorescence due to a photo induced electron transfer (PET) process. It was found that ATP can readily displace adsorbed DNA from nanoceria surface because of the stronger coordination ability of ATP with nanoceria, and the nanoceria-based competitive binding resulted in over 7-fold fluorescence enhancement. Over a wide range from 0.1 nM to 1.5 μM, a good linear relationship between the fluorescence intensity and the concentration of ATP was obtained and the detection limit was estimated to be as low as 54 pM. This method was successfully used to analyze ATP in a single drop of blood and human urine.

Keywords

Nanoceria, ATP, Fluorescence, FAM-DNA

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