Ultrasensitive bio-detection using single-molecule observation of target-induced gold nanoparticles aggregation

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Abstract: Sensitive detection of biomolecules such as proteins and DNA is important in medical diagnosis and bioscience research. We have developed a new method utilizing dark field microscopy (DFM) for the detection of nanoparticle aggregation induced by target biomolecules. Since DFM can detect scattered light from individual single metal nanostructures to examine AuNP aggregation, it is expected that a small amount of AuNP aggregates can be detected with DFM, which is difficult with the previous ensemble measurements. Previously we could detect DNA molecules at sub-pM level. In the present work, we employed this method to detect amyloid beta (Aβ) protein fibrils. Since Aβ aggregates are neurotoxic and are considered to cause Alzheimer’s disease, detection of Aβ aggregates is important for early recognition of diseases. We demonstrated that LOD of Aβ fibrils using this method reached as low as pM level. These insights should also open opportunities for the use of DFM in various analytical methods using NP assembly.

Keywords: Sensitive detection; Gold nanoparticles; Single molecule observation