In-situ Investigation of Surface Plasmon Resonance Enhanced Fluorescence Property during Deposition of Gold Quantum Dots on Polyelectrolyte Multilayers

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In this study, we present in-situ investigation of surface plasmon enhanced fluorescence emission from the gold quantum dots (AuQDs) during the deposition on polyelectrolyte multilayers ultrathin films. When the diameter of gold particles becomes less than 2 nm, they are called gold quantum dots (AuQDs) or gold nanoclusters, on which localized surface plasmons cannot be excited. Instead, the AuQDs exhibit quantum confinement effects, meaning that the number of gold atoms in the AuQDs determines the wavelength of the fluorescence emission in the visible range. This implies that AuQDs can harvest light from the UV region and convert it into visible light.[1,2] By using the quenching / enhancement phenomenon, AuQDs have been applied to biosensor, organic electronic devices, and so forth. In this work, we studied the quenching / enhancement phenomenon of AuQDs by controlling the thickness of polyelectrolyte multilayers ultrathin films (intermediate layer) between the metal and AuQDs. Poly (diallyldimethylammonium chloride) (PDADMAC) and poly (sodium 4-styrenesulfonate) (PSS) were used as the polyelectrolyte layers. First, the polyelectrolyte multilayer was deposited on an aluminum surface using a layer-by-layer (LbL) adsorption technique by sequentially dipping the aluminum-coated high refractive index glass substrate into an aqueous solution of the positively charged PDADMAC and negatively charged PSS. Finally, a monolayer of AuQDs is deposited on PDADMAC/PSS films by spin-coating technique. The fluorescence quenching / enhancement of AuQDs by controlling the thickness of PDADMAC/PSS bilayers was monitored by surface plasmon resonance enhanced fluorescence measurement as schematically shown in Fig. 1.[3,4] As the number of PDADMAC/PSS films increased up to 12 layers, the fluorescence intensity of the AuQDs increased. Then, the fluorescence intensity decreased when the number of layer became more than 12 layers. As shown in Fig. 2, the optimum distance between the AuQDs and aluminum layer is 12 layers, i.e. ca. 20 nm. Further studies relating to H_2O_2 sensing technique based on the fluorescence quenching and wavelength shift of AuQDs with AgNPs are under way.

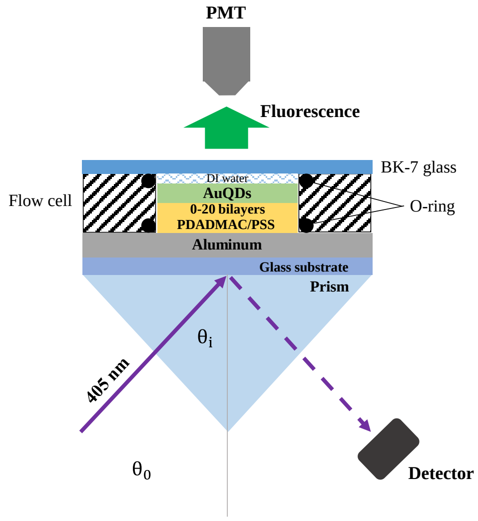

Fig. 1. SPR experimental in the Kretschmann configuration.

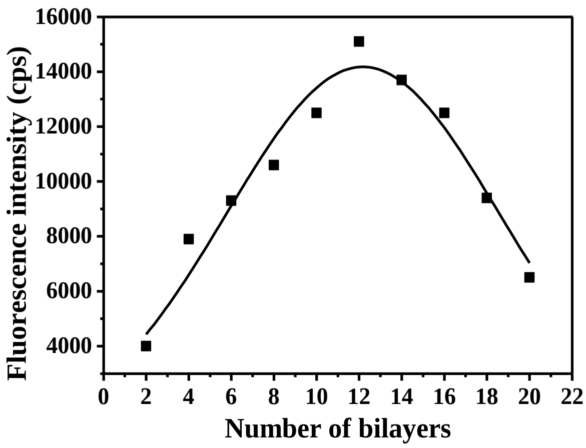

Fig. 2. Surface plasmon enhanced fluorescence of AuQDs on polyelectrolyte multilayers as a function of number of layer of PDADMAC/PSS films.

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