Plasmon-Enhanced Fluorescence Dynamics of the Major Plant Light-Harvesting Complexes

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The photosynthetic light-harvesting complex II of plants, known as LHCII, possesses an excellent ability to harvest solar energy and transfer the excitation energy to the photosynthetic reaction centre with near-unity quantum efficiency. In addition to light-harvesting, LHCII plays a photoprotective role under high-light intensities. The nature of the energy transfer dynamics and the underlying photoprotective mechanisms in LHCII are subjects of intense research. Unfortunately, individual LHCII complexes suffer from low intrinsic fluorescence and poor stability at high illumination intensity, which limits the amount of information that can be retrieved. I will show that chemically synthesized gold nanorods can enhance the fluorescence brightness of individual LHCII complexes by two orders of magnitude and simultaneously decrease the fluorescence lifetime of the complexes by two orders of magnitude. The strong enhancement was achieved by carefully tailoring the longitudinal localized surface plasmon resonance of the nanorods to match the absorption and emission bands of LHCII. This study provides an inexpensive strategy to explore the fluorescence dynamics of weakly emitting photosynthetic light-harvesting complexes at the single molecule level.