

Excited-state dynamics of colloidal gold nanoshells functionalized with trimethoxysilylazachalcones

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Streszczenie

In this study, we present a new synthetic approach to obtain trimethoxysilylazachalcones, a family of donor–acceptor chromophores exhibiting strong intramolecular charge-transfer behavior. Their distinct optical features, validated through comprehensive spectroscopic analysis and theoretical modeling, make them promising candidates for advanced functional applications. To harness and further enhance their photophysical potential, the chromophores were covalently anchored onto plasmonic gold nanoshells (NSs), forming hybrid nanostructures engineered for enhancing excited state processes through plasmon–molecule interactions. Femtosecond transient absorption spectroscopy revealed pronounced differences in the excited-state dynamics between the free and hybrid systems. While several plasmon-related processes, such as local electromagnetic-field enhancement, hot-electron transfer to the molecular LUMO, and the suppression of non-radiative decay through restricted molecular mobility and strong interfacial electronic coupling-are possible, we believe that the dominant contribution in our measurements arises from nanoparticle heating and its resulting thermal response. The results underscore the potential of such plasmon-enhanced hybrid materials in technologies where control over excited-state dynamics is essential. Applications span photonic devices, optical sensors, and light-triggered biomedical tools such as photodynamic therapy and high-resolution bioimaging, where prolonged excited-state lifetimes can directly translate into improved functionality and sensitivity.

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