Linear and nonlinear optical properties of new materials bound to biomolecules

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During my PhD project the incorporation and manipulation of several different classes of light-activated compounds into finely defined 3D natural host systems including nucleic acids and proteins have been performed aimed by the possibility to obtain hybrid composite materials with enhanced optical and biological properties. In particular, fluorogenic dyes, nonlinear bioprobes, achiral and chiral molecular photoswitches have been implemented into biological matrices to gain insights into the resulting complexation processes. We proved that some of these photonic agents could act as DNA binders either through intercalation or minor grove binding. We recently found that a macromolecular two-photon fluorophore based on anthracenyl scaffold was able to selective detect and discriminate between canonical and noncanonical DNA topologies as well as closely related serum proteins (human serum albumin and bovine serum albumin). We also reported on the ability of a series of novel molecular photoswitches to induce DNA conformational changes (B-to-A and B-to-A-to-Z DNA transitions) and to work efficiently as amplifiers of molecular chirality. In this framework, we discussed in detail how the change in shape occurring on the photoisomerization process could be used to build supramolecular assemblies with enhanced chirooptical properties. We also investigated the molecular recognition operated by helicene-like molecules toward right-handed double-stranded genomic DNA and right- and left-handed guanine rich oligonucleotides forming G-quadruplexes. In conclusion, the results gained during my PhD project may provide a platform toward the conception of new molecular agents that can find applications at the interface between materials science and molecular biology.