Development of H_2O_2 supramolecular micro-probes with excitation and emission in the visible region of the spectrum

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Hydrogen peroxide (H_2O_2) and other reactive oxygen species (ROS) are a family of reactive molecules that are produced in cells and act as signaling molecules in metabolic pathways. However, an overproduction of oxidative species in the cellular environment has been related to conditions such as chronic inflammation, diabetes, Alzheimer's disease and cancer. Many probes of H_2O_2 have been reported, but it remains a challenge to develop H_2O_2-responsive systems that respond to changes in H_2O_2 concentrations in vivo with good biocompatibility. We have developed a set of turn-on aryl boronic ester probes (BEPs) that are oxidized by H_2O_2, yielding a fluorescent product. We also developed supramolecular hacky sacks (SHS), which are microglobular particles formed from the hierarchical assembly of supramolecular G-quadruplexes that encapsulate BEPs leading to fluorescent micro-probes for H_2O_2. Preliminary studies of the micro-probes showed a need to shift the fluorescence of the BEPs to longer wavelengths (red-shift) to perform more effective in vitro studies. We synthesized new BEPs by a Claisen-Schimdt condensation, using acetophenone and 4-boronic ester naphthaldehyde, and the Knoevenagel condensation using different boronic ester aldehydes and malononitrile, increasing the conjugation and the excitation wavelength of these molecules. These BEPs were synthesized with reasonable yields and were characterized by UV/Vis spectroscopy, fluorescence spectroscopy and 1D/2D NMR. By thoroughly studying the photophysical properties of these micro-probes, we will be closer to our goal of developing biocompatible supramolecular H_2O_2 probes.