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# Synthesis and photophysical behavior of fluorescent benzazole dyes and fluorescent microparticles: Their use as fingerprint developer

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ABSTRACT

Novel benzazole derivatives were synthesized and their photophysical properties were determined experimentally in different types of solvents also by theoretical calculations using Density Functional Theory (DFT). The results of the theoretical computational studies were well consistent with those observed experimentally, evidencing the type of electronic transitions that occurs between the frontiers orbitals. All synthesized derivatives are highly fluorescent in the violet-green region (363–536 nm) under ultraviolet light of 365 nm with large Stokes shift due to excited state intramolecular proton transfer (ESIPT) mechanism. Furthermore, the thermogravimetric and differential thermogravimetric analysis showed their good thermal stability, with decomposition temperature up to 250 °C. The fluorescent benzazole derivative was successfully entrapped into starch-based microparticles and applied for visualization of latent fingerprints on different types of surfaces common to forensic cases (metal, plastic, paper, wood, and ceramic).

## 1. Introduction

The benzazolic compounds have shown several innovative applications such as optical and biological sensors [1–4], laser dye [5], organic light emitting devices [6,7], and in forensic science as developer for latent fingerprints [8,9], and bloodstains [10]. These potential applications are mainly due to their excellent thermal, photochemical and photophysical stability [11–13]. Many of these compounds can undergo the excited state intramolecular proton transfer (ESIPT) mechanism, which is an important characteristic for optical applications due to the low self-absorption of fluorescence. The ESIPT mechanism is a photo-induced process in which a proton is transferred from a proton donor (—OH, —$NH_2$) to a proton receptor (—C═O, —N═) when they are nearby [14,15].

Over the last years, the entrapment of organic dyes into solid inorganic or organic matrices, such as silica or starch, has been an interesting approach for obtaining hybrid materials with applications in different areas of science [16–18]. In addition, the incorporation of dye into matrices host increases the fluorescence yield and photostability of the dye, as well as improve the optical properties of these materials [19–21]. Various organic dyes doped into different materials have been reported in literature [22,23]. For example, their effectiveness for latent fingerprints detection on different types of surfaces was assessed by Rowell [24] and Sodji et al [25], where the authors demonstrated several advantages over conventional powder, especially those that have luminescent properties. In our previous work, we have successfully developed novel fluorescent materials based on silica and starch matrices doped with benzazole dyes and applied them for visualization of fingermarks on porous and non-porous surfaces [9,26]. The visualization of latent fingerprint with good efficiency by using cheap, non-toxic, and natural developers is one of the major challenges associates with human identification in forensic cases. Recently, many fluorescent developers, usually micro and nanomaterials [27,28] have been proposed as an alternative to the commercial developers due to the good contrast and poor background interference of processed fingerprint. In light of this, the objective of this study was to synthesize and characterize four benzazole derivatives with hydrophilic groups that allow the interaction and entrapping into starch matrix, which is an abundant, low cost, non-toxic and natural polymer. The obtained fluorescent microparticles were successfully evaluated in the development of fingerprints

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