

Catalytic Degradation of Pharmaceuticals by Ferrocene-Modified Polypyrrole Nanoparticles

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The rapid development of medicine and pharmacy observed in recent decades has significantly improved people's quality of life and average lifespan, largely due to patients taking appropriately selected effective pharmaceuticals. However, the prevalence of drugs reaches an alarming level, as evidenced by statistics conducted in the United States in 2021, which show that more than half of Americans take medications prescribed by doctors every day [1]. Such high demand generates the increase in the content of drugs and their metabolites in the environment yearly, exposing flora, fauna, and people themselves [2].

More than ever, it is therefore necessary to focus on materials that effectively break down pharmaceuticals and explore ways to use these materials in the large-scale purification of environmental samples from undesirable chemicals. The polypyrrole nanoparticles we synthesized and then chemically modified with a ferrocene derivative proved an excellent matrix for the photochemical degradation of duloxetine – one of the most popular drugs against depression. Their small size of around 50 nm implies a high surface-to-volume ratio, making them an excellent material for heterogeneous catalysis (Figure 1a). Our study demonstrated the photochemical activity of ferrocene-modified polypyrrole nanoparticles (NP2F) after irradiation of aqueous solutions of duloxetine with an ultraviolet lamp. The changes in drug concentration over time during photochemical degradation activity were controlled using UV-Vis spectrophotometry. Our preliminary results showed that only two hours of UV irradiation in the presence of a 1% suspension of nanoparticles was enough to degrade approx. 50% of the drug (Figure 1b), which sheds light on the potential use of our material for large-scale applications.

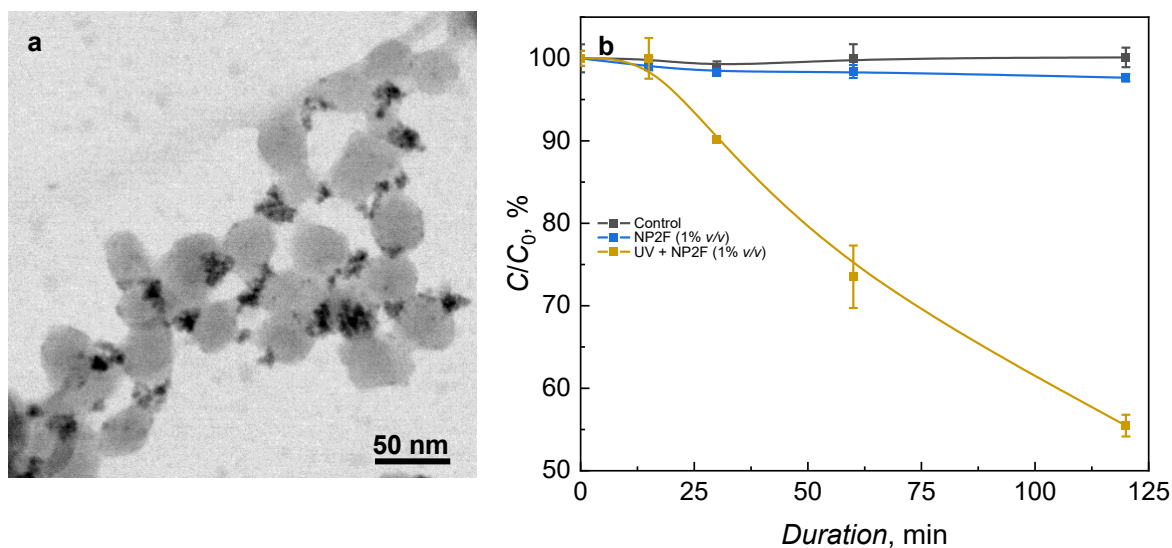


Figure 1: (a) TEM image of ferrocene-modified polypyrrole nanoparticles. (b) Concentration profiles of duloxetine degradation observed in the presence of ferrocene-modified polypyrrole nanoparticles alone and under UV irradiation. Control measurement was performed in the absence of NPs and UV.

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References

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