

DOCTORAL THESIS

Synthesis, characterization and application of thermo-responsive [1] pseudorotaxane prepared by slippage approach

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Abstract

This thesis is divided into three sections. The first section of the thesis includes the synthesis and characterization of a catechol-containing [2]pseudorotaxane which established a model for pseudorotaxane formation prepared through slippage method. The pseudorotaxane formation is performed in different solvents at elevated temperature in a period of time and the progress of pseudorotaxane formations were monitored with ^1H NMR spectroscopy. The [2]pseudorotaxane had been successfully synthesized in acetonitrile (MeCN) at 60 °C for 5 d with 29% yield.

The second section of the thesis demonstrates the potential of the [1]pseudorotaxane to work as a nanovalve. The opening of valve had been investigated and quantified in the presence of external stimuli such as heat, ultrasound, pH and alternating magnetic field (AMF). Furthermore, a novel core-satellite Fe_3O_4 nanocomposite had been prepared for AMF responsive controlled drug released system. The cytotoxicity of the core-satellite Fe_3O_4 nanocomposite had also been investigated and quantified in human gingival epithelial cells and

human epithelial cell line, FaDu, from a squamous cell carcinoma of the hypopharynx. The core-satellite Fe₃O₄ nanocomposite showed non-cytotoxicity at concentration lower than 200 µg/mL and 100 µg/mL towards HGEPs and FaDu respectively.

The third section of the thesis illustrates the synthesis of a novel [1]pseudorotaxane from a signal compound which consists of a macrocycle and a coordination site through a slippage approach. The formation of mechanically interlocked molecules restricted the twisted intramolecular charge transfer (TICT) quenching process and an enhancement of fluorescence intensity was observed. With a potential to act as a fluorescent probe, the fluorescence and fluorescence-quenching nature of the [1]pseudorotaxane had been investigated and quantified in the presence of external stimuli such as base, acid and salt. Furthermore, a series of cations and anions had been screened. The results suggested that the [1]pseudorotaxane was a highly selective phosphate ion sensor and working with a linear operating mode.

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