Loading of an anti-cancer drug into mesoporous silica nano-channel and subsequent release to DNA

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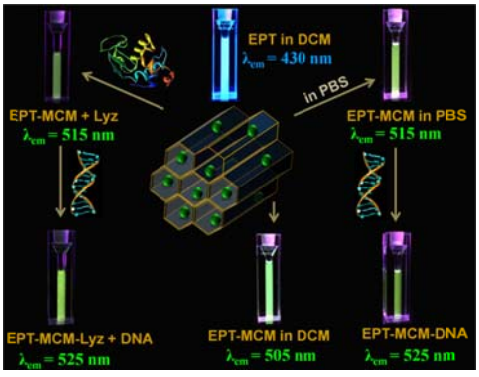
Abstract:
Recently, Mesoporous silica nano-channel (MCM-41) have shown vast impact in bio-medical applications, especially in the targeted delivery and controlled release of anticancer drugs.[1,2] Due to its large surface area, pore volume, highly ordered pore structure, adjustable pore size of MCM-41 are useful in high drug loading. Moreover, its low toxicity, cell penetrating ability and chemical stability incited researchers to design this as a drug delivery vehicle.[3] MCM-41 based molecular switching of a biologically important anticancer drug, namely, ellipticine (EPT) has been utilized to probe its efficient loading onto MCM-41, and subsequent release to intra-cellular biomolecule, like, DNA. Exploiting various spectroscopic techniques (like, steady state fluorescence, time-resolved fluorescence and circular dichroism), it has been shown that EPT can be easily translocated from MCM-41 to DNA without using any external stimulant. Blue emission of EPT in polar aprotic solvent i.e, dichloromethane completely switches to green upon loading inside MCM-41 due to the conversion from neutral to protonated form of the drug inside nano-pores. Here, lysozyme (Lyz) protein has been utilized as a pore blocker of MCM-41 in order to prevent premature drug release. Interestingly, EPT is released to DNA even from the EPT-MCM-Lyz composite system, and results in intensification of green fluorescence. We can easily probe the loading/releasing process of drug by seeing the change in fluorescence colour. Electron microscopy results reveal the formation of distinctive garland kind of morphology involving MCM-41 and DNA probably through non-covalent interactions, and this is believed to be responsible for the DNA assisted release of drug molecules from silica nano-pores. Confocal laser scanning microscopy (CLSM) imaging revealed that EPT-MCM successfully internalized into the Hela cervical cancer cells and localized into the nucleus. Cell viability assay results infer that EPT-MCM and Lyz-EPT-MCM showed much improved efficacy in HeLa cancer cells compared to free ellipticine.[4]



Scheme. Fluorescence-switching of ellipticine (λ_{ex} = 350 nm) in presence of MCM-41 and various biomolecules (Lyz/DNA).

References and Notes:

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