

Multifunctional single-layered vesicles derived from Cu(II)-Metal-Organic-Polyhedra

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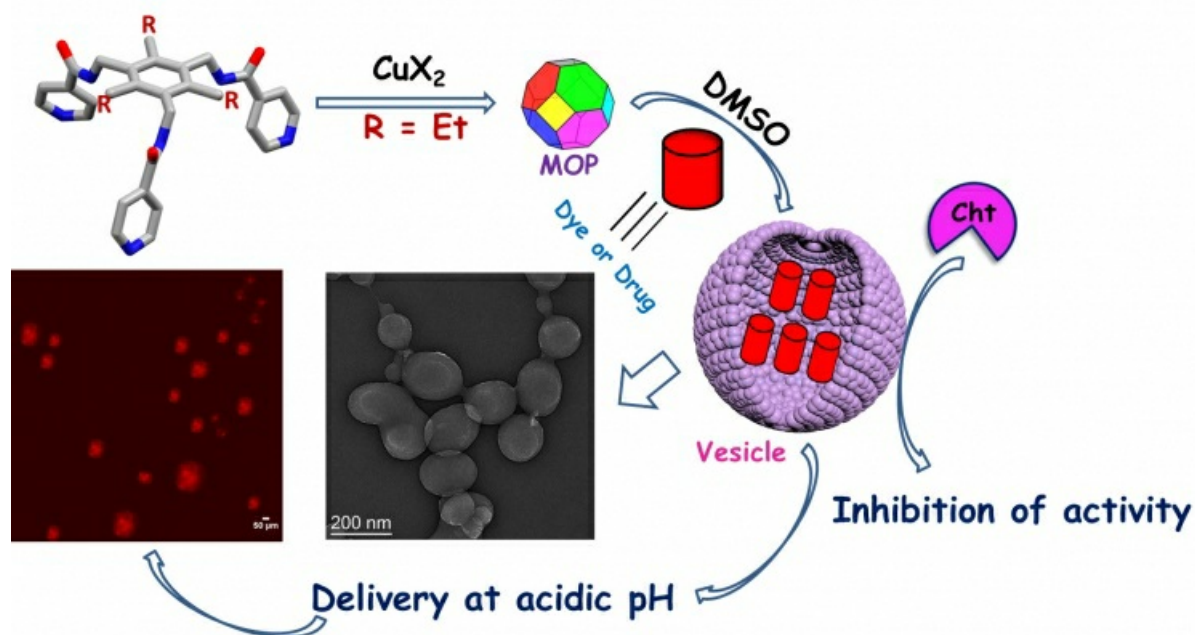
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Vesicles are versatile nanostructures generated by the hierarchical self-assembly of lipid molecules. The morphology of vesicle is usually spherical having hollow core filled with solvents. In cell biology, vesicles take part in important biological functions such as metabolism, transport, enzyme storage etc. Vesicles derived from synthetic amphiphilic organic molecules are well studied and many of them are multifunctional (drug delivery, sensing, catalysis etc.). However, vesicles from metal-organic hybrid systems such as metal-organic polyhedra (MOP) or nanocages are scarcely reported and multifunctional vesicle derived from MOP is hitherto unknown. Herein, we report single-crystal-X-ray-diffraction-characterized two Cu(II) MOPs derived from a C₃-symmetric tris-pyridyl ligand namely 1,3,5-tris(isonicotinamidomethyl)-2,4,6-triethylbenzene (L2). At low concentration in DMSO, these MOPs formed multifunctional vesicles; the vesicles could encapsulate calcein (a fluorescent dye) and doxorubicin (an anti-cancer drug). It was also possible to release the anti-cancer drug from the vesicle in vitro in a pH responsive manner. The vesicles were found to be stable under physiological condition allowing cytotoxicity and cell imaging studies to be performed with the doxorubicin encapsulated vesicles in RAW 264.7 cells. One of the vesicles was found to inhibit alpha-chymotrypsin more efficiently than the other establishing the difference in anisotropy of the charge surface of these vesicles which corroborated well with the single crystal structures of the MOPs. Thus, the MOP derived vesicles reported herein not only represent the rare examples of such hierarchical architecture derived from MOPs but also provide the first example of multifunctional organic-inorganic synthetic bio-membrane. It was observed that the methyl substituted ligand L1 produced three isomorphous coordination polymers displaying 2D open framework structures namely [Cu(L1)(ClO₄)•4DMF]_n CP1, [Cu(L1)(BF₄)•4DMF]_n CP2 and [Cu(L1)(NO₃)•4DMF]_n CP3 as revealed by single crystal X-ray diffraction (SXRD) due to anti conformation with respect to the pyridyl arms thereby preventing MOP formation.

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