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Porous-wall hollow glass microspheres (PWHGMs) are a novel form of glass materials that consist of 1-µm-thick porous silica shells, 20-100 µm in diameter, with a hollow cavity in the center. Utilizing the central cavity for material storage and the porous walls for controlled release is a unique combination that renders PWHGMs a superior vehicle for targeted drug delivery. In this study, NMR spectroscopy was used to characterize PWHGMs for the first time. A vacuum-based loading system was developed to load PWHGMs with various compounds followed by a washing procedure that uses solvents immiscible with the target material. Immiscible binary model systems (chloroform/water, n-dodecane/water), as well as the hydrolysis of isopropyl acetate, were investigated to obtain NMR evidence for material loading into PWHGMs and their subsequent release to the surrounding solutions. The NMR peaks of the loaded materials were distinguishable from the NMR peaks of the materials in the surrounding solution. The formation of the reaction product isopropanol provided evidence of encounters of isopropyl acetate in the microspheres and concentrated H_2SO_4 added to the surrounding solution. Also, microspheres loaded with H_2O were suspended in D_2O and monitored to obtain quantitative release kinetics of H_2O encapsulated in PWHGMs. A five-parameter double-exponential curve fit of experimental signal intensity data as a function of time indicated two release rates for H_2O encapsulated in PWHGMs with time constants of 18 - 20 minutes and 160 minutes. The results demonstrate that NMR is a particularly useful tool to study developments and applications of PWHGMs in targeted drug delivery.

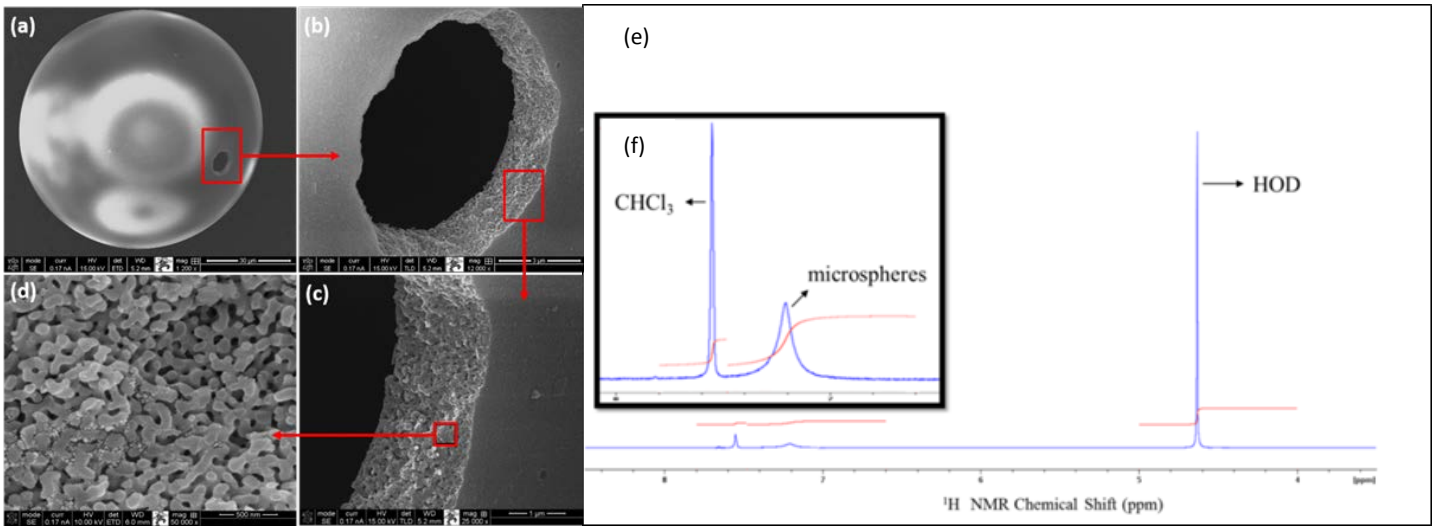

Figure 1. SEM images of microsphere shell and ^1H NMR spectrum of $CHCl_3$ inside of the microspheres suspended in D_2O. (a) a hole on the microsphere surface; (b) the enlarged hole; (c) interception of the microsphere shell; (d) channels through the microsphere shell; (e) peaks from left to right are assigned to dissolved $CHCl_3$ in D_2O (7.55 ppm), $CHCl_3$ inside microspheres (7.20 ppm), and HOD (4.63 ppm); (f) expansion of NMR spectrum from 8 ppm to 6.5 ppm showing a comparison of the dissolved $CHCl_3$ peak with the microspheres peak