Encapsulation and Stability Properties of Nanoengineered Polyelectrolyte Capsules for Use as Fluorescent Sensors

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This is the first report about a novel fluorescence sensor technology based on hollow micro- and nanoscale polyelectrolyte capsules. The nanostructured shells were constructed using the electrostatic layer-by-layer assembly process to deposit multilayer polyion films onto microtemplates (melamine formaldehyde microspheres). The latex cores were subsequently dissolved and removed, leaving hollow shells. The capsules were then loaded with a model fluorescent assay consisting of a sodium-sensitive dye and a reference fluorophore. Fluorescence spectroscopy was used to analyze properties of the capsules with respect to their potential application as biosensors. The results show that multiple dye molecules can be introduced into the interior of the capsules with excellent control over relative levels, and the capsules retain >99% of fluorescence during 30 days of storage in a buffer. The findings also demonstrate that the capsules are mechanically robust, and only extremes in solvent pH cause significant leaching of fluorophores from the interior of the shells. Finally, results from sodium sensitivity experiments suggest that capsules have excellent potential for use as sensors, with a highly linear response over a broad range (0–100 mM).