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Microfluidic-assisted formation of highly monodisperse and ordered mesoporous silica bioglasses microcapsules

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In this work developed recently an original approach using droplet-based microfluidics and the ESE techniques for the fabrication of well-defined monodisperse mesoporous silica bio glasses (85S5) hollow microspheres (microcapsules) whose size, shape and composition can be varied on demand. Our original approach allows producing highly monodisperse mesoporous and hollow silica bio glasses microspheres which is much simpler and straight forward than the time consuming and tedious standard technique as the latter relies on the use of a sacrificial hard template on which silica solidifies and forms a mesoporous shell, followed by the selective removal of the template. Our approach consists of one-step procedure as the formation of the silica shell is driven only by a control of the balance between the solvent evaporation and the silica solidification rates at the surface of the microdroplets. A step in our approach is that the control of the evaporation process is conducted outside the microfluidic channels since we use highly diluted solutions of the silica precursor (TEOS) droplets and a fluorinated oil as a carrier medium in which solvents (water ad ethanol) contained in the droplets do not solubilize. Understanding the broad variety of the observed behaviours is highly relevant to many applications. We vary the size of the microdroplets, the concentration of the precursor molecules (TEOS), the nature of the surfactant used against coalescence.

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