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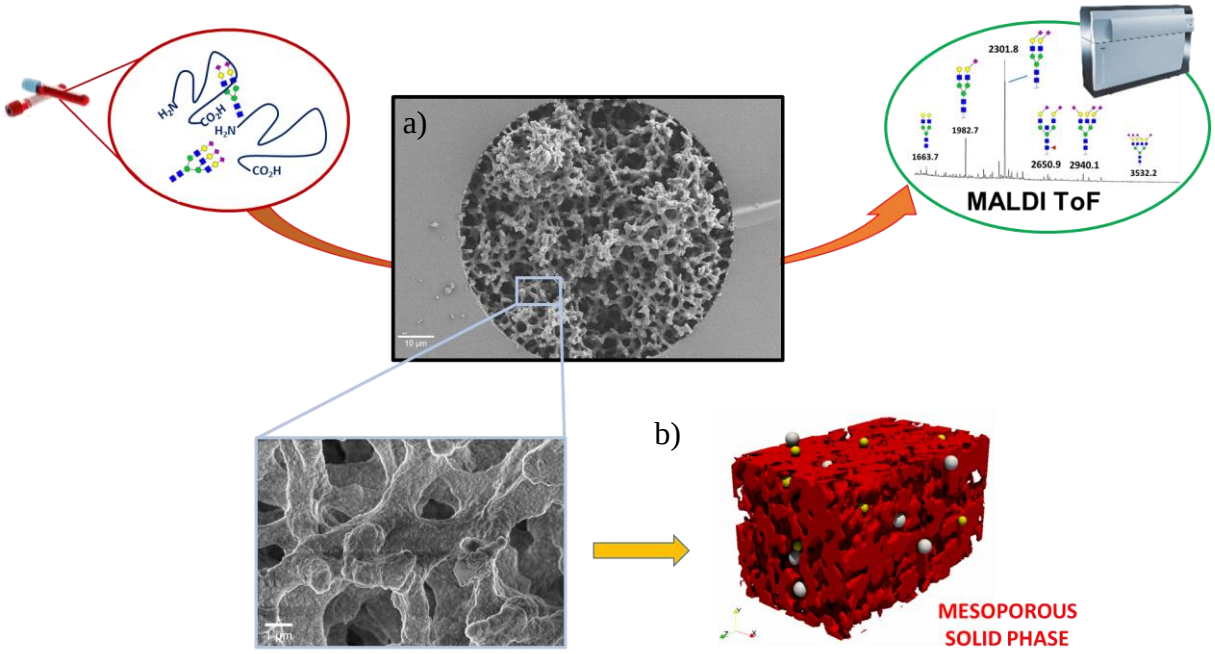
ABSTRACT:

Hierarchical porosity sol-gel monoliths (HPMs) are of increasing interest for a wide variety of applications due to their outstanding microstructural (homogenous) and textural properties (high porosity and specific surface area) [1]. The high flow rate and low-pressure resultant compared to conventional materials, makes them suited for extraction and enrichment of analytes of interest in analytical techniques (HPLC, SPE, etc.) [2–4]. However, pure inorganic materials have rarely been considered for relevant applications in various omics fields such as metabolomics or proteomics [5].

In the context, we report on: (i) a pure silica HPM based on a finely tuned bimodal porosity thoroughly controlled, (ii) coupled to a new way to a miniaturize shaping (iii) and its use as an innovative tool for sample preparation prior to glycan analysis by mass spectrometry, as a new source of disease biomarkers (glycomics analysis).

The monolith synthesis will be presented with a special emphasize on its robustness and on the modulations of the bimodal porosity obtained ([0.1–5] µm and [1-25] nm). Beside microstructural and textural properties measurements (SEM, Hg porosimetry, etc.), the transport of small molecules through mesoporous network were evaluated by TEM tomography. Finally, the material was processed in different shapes and size (50 µm – 4 mm in diameter) demonstrating a high flexibility of our approach to produce devices dedicated to a biological analysis. The use of HPM for the analysis of both free and protein-bound oligosaccharides present in precious samples (human blood and milk) and their detection by MALDI-TOF mass spectrometry will be presented as a proof of concept. Optimized experimental conditions, as well as material textures and shapes, enabled straightforward and time-efficient purification and MS-based glycomics analysis using minute quantities (few µl) of solvents but above all of complex human biofluids, thus outperforming common laboratory protocols.

Figure 1 : a schematic of the adapted procedure for the analysis of N-glycan comprising : a) SEM micrographs of the typical microstructure of a porous material prepared and used in this study b) a 3D reconstruction of mesoporosity obtained by TEM tomography



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