A simple method for the production of large volume 3D macroporous hydrogels for advanced biotechnological, medical and environmental applications

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Abstract

The development of bulk, three-dimensional (3D), macroporous polymers with high permeability, large surface area and large volume is highly desirable for a range of applications in the biomedical, biotechnological and environmental areas. The experimental techniques currently used are limited to the production of small size and volume cryogel material. In this work we propose a novel, versatile, simple and reproducible method for the synthesis of large volume porous polymer hydrogels by cryogelation. By controlling the freezing process of the reagent/polymer solution, large-scale 3D macroporous gels with wide interconnected pores (up to 200 Î 1/4m in diameter) and large accessible surface area have been synthesized. For the first time, macroporous gels (of up to 400 ml bulk volume) with controlled porous structure were manufactured, with potential for scale up to much larger gel dimensions. This method can be used for production of novel 3D multi-component macroporous composite materials with a uniform distribution of embedded particles. The proposed method provides better control of freezing conditions and thus overcomes existing drawbacks limiting production of large gel-based devices and matrices. The proposed method could serve as a new design concept for functional 3D macroporous gels and composites preparation for biomedical, biotechnological and environmental applications.

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