3D spheroid culture. Thus, the development of more efficient tissue-mimetic 3D culture systems that improve the long-term expansion of robust and stem-like cell populations are currently still under investigation. One promising approach is the utilization of hydrogel systems. However, the current utilization of hydrogel systems have aimed to control differentiation and/or act as a delivery vehicle of stem cells, rather than to expand MSCs and maintain their stem-like properties. Additionally, most current hydrogel formulations lack the porous microarchitecture that aids in cellular migration and nutrient diffusion.

Therefore, there remains a need in the art for simplified and efficient platforms that enable three-dimensional continuous growth of a variety of cells and/or tissues, particularly platforms that more closely mimic or resemble *in vivo* conditions associated with a natural cell and/or tissue of interest.

SUMMARY OF INVENTION

In one aspect, provided herein is an interlocking porous hydrogel block (IPHB), comprising:

a three-dimensional (3D) macrostructure defined by a continuous polymeric matrix material and a network of microporous channels and/or chambers extending throughout the continuous polymeric matrix material;

the 3D macrostructure comprises a top surface, a bottom surface, and a thickness defined by at least one side edge extending from the top surface to the bottom surface, and wherein the 3D macrostructure structure includes at least one interlocking-male component and at least one interlocking-female component.

One or more embodiments of the invention may address one or more of the aforementioned problems. Certain embodiments according to the invention provide an interlocking porous hydrogel block (IPHB) comprising a three-dimensional (3D) macrostructure defined by a continuous polymeric matrix material and a network of microporous channels and/or chambers extending throughout the continuous polymeric matrix material. The 3D macrostructure may comprise a top surface, a bottom surface, and a thickness defined by at least one side edge extending from the top surface to the bottom surface, in which the 3D macrostructure includes at least one interlocking-male component and at least one interlocking-female component. In accordance with certain embodiments of the invention, the at least one interlocking-male component of a first IPHB is configured to be received within a corresponding at least one interlocking-female component of a second IPHB.

In another aspect, the present invention provides a scaffolding system comprising a plurality of IPHBs, such as those described and disclosed herein. In accordance with certain embodiments of the invention, for instance, the plurality of IPHBs includes a first IPHB including a first interlocking-male component and a second IPHB including a second interlocking-female component, in which the second interlocking-female component is configured to receive the first interlocking-male component.

In another aspect, the present invention provides a method of forming an IPHB comprising the formation of polymeric melt and printing, such as 3D printing, a continuous polymeric matrix material and a network of microporous channels and/or chambers extending