MANUFACTURING OF SKAFOLDS FOR 3D CELL CULTURE USING NEWLY DEVELOPED WATER-SOLUBLE FREE-RADICAL PHOTOINITIATORS

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ABOUT THE INVENTION

The present invention develops previously unknown water-soluble radical photoinitiators for use in biomedical applications. The developed compounds are type I initiators that undergo hemolytic degradation when exposed to light in the visible range (safe for use with cells). The performance of these photoinitiators has been investigated using real-time FTIR techniques during radical photopolymerization reactions of acrylate monomers based on polyethylene glycol or their mixtures with water. The proposed new radical photoinitiators proved to be effective both during the polymerization of acrylate monomer and during photopolymerization processes in aqueous medium - in obtaining hydrogel. The short induction time, high speed of the photopolymerization process and high monomer conversion rates made it possible to use these photoinitiators to obtain three-dimensional hydrogel materials with a defined structure. By using the developed photoinitiators, hydrogel materials with excellent optical resolution and accuracy with respect to the computer model were obtained, and these materials have applications as 3D cell culture scaffolds, as evidenced by biological studies.

SPECTROSCOPIC CHARACTERISTICS

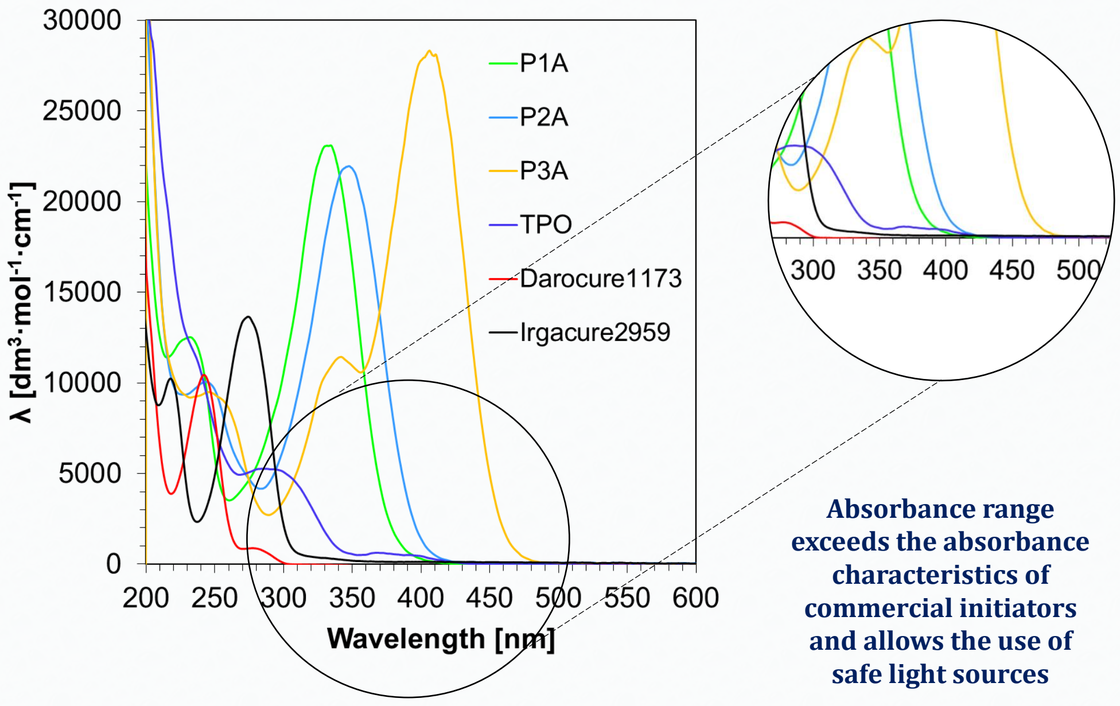

Fig. 1. Absorbance characteristics of exemplary initiators being the subject of the invention and absorbance spectra of common commercial initiators.

GYRIOD TYPE HYDROGELS PRINRING AND MONITORING OF THE REACTION

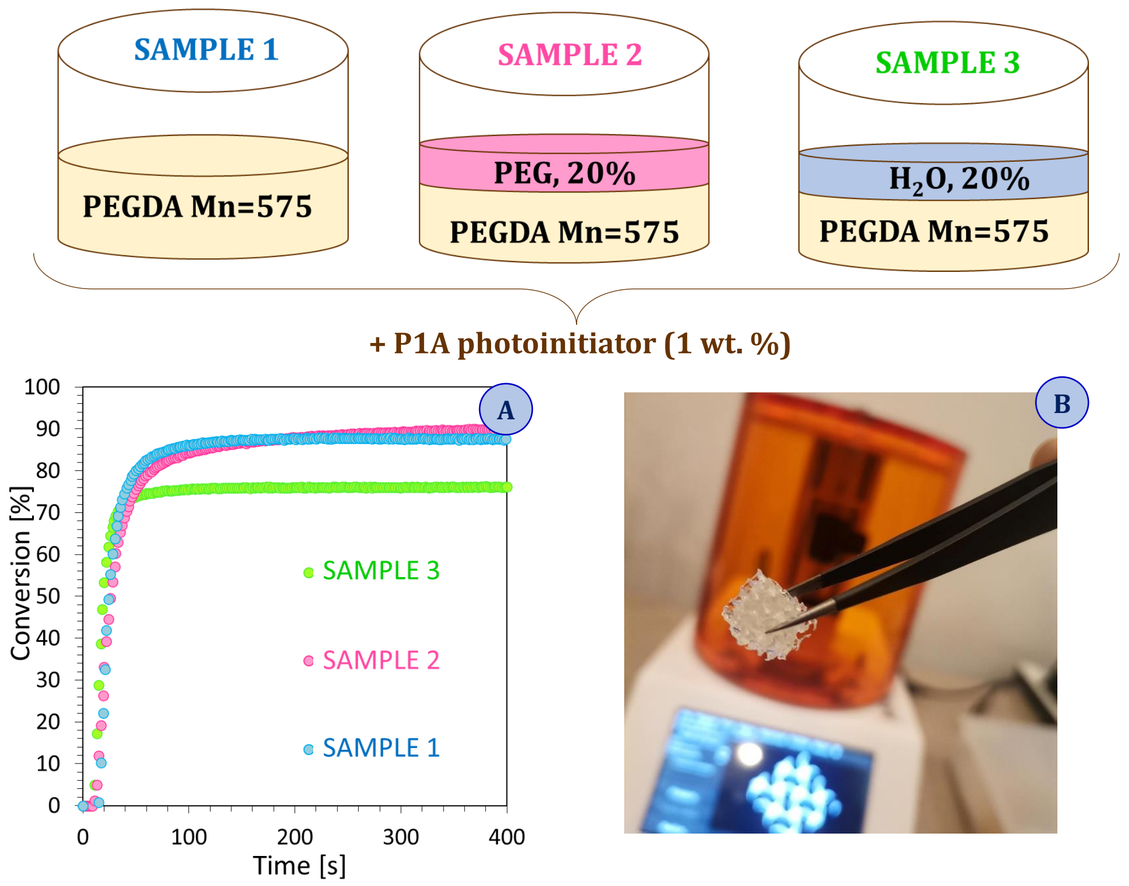

Fig. 4. (A) Kinetics of the radical photopolymerization process during the preparation of hydrogel materials under 405 nm light irradiation, with an intensity of 1000 mA , **(B)** Photo of the obtained gyroid cube-shaped hydrogel (photo in the background of the 3D printer used to prepare the material: LumenX, by CellInk).

EXCELLENT ACCURACY AND PRECISION → HYDROGEL SCAFFOLDS FOR 3D CELL CULTURE

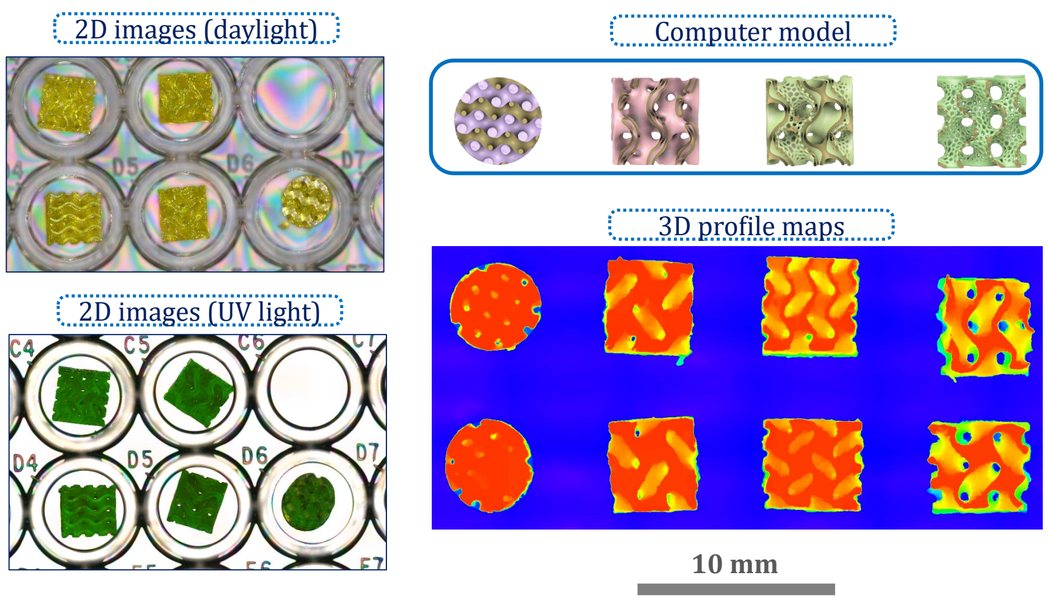

Fig. 2. Photo of a prinout with a macroporous structure; comparison of the computer design and the resulting hydrogel material (2D and 3D profile map obtained from optical microscope).

3D PRINTING OF HYDROGELS WITH HIGH RESOLUTION AND PRECISION

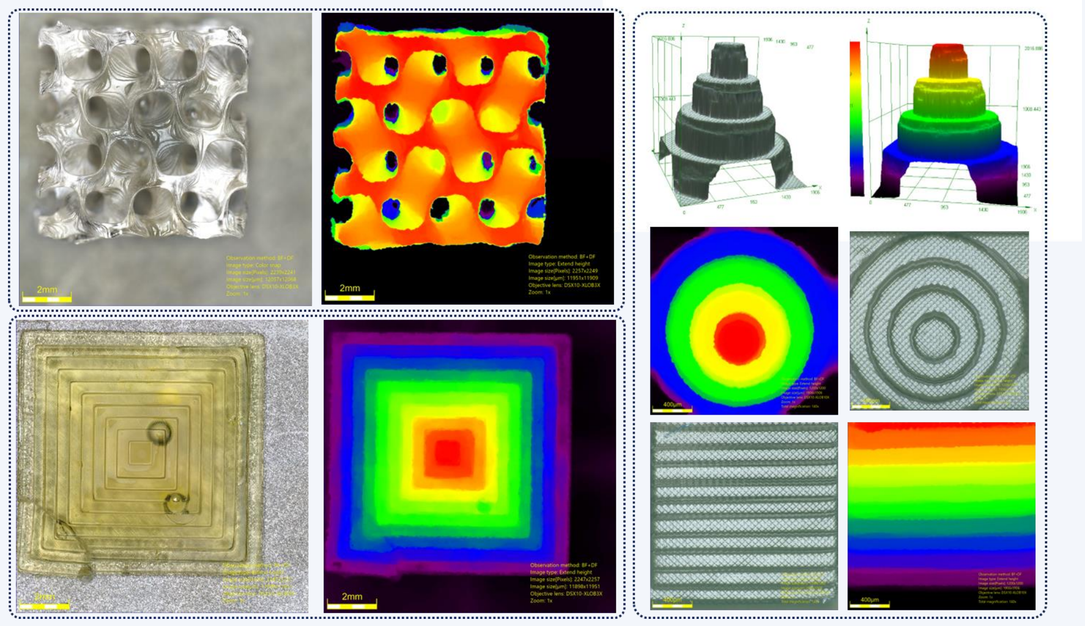

Fig. 5. Photo of a prinout with a macroporous/solid structure; comparison of the computer design and the resulting hydrogel material (2D and 3D profile map obtained from optical microscope).

PRINTING OF PRECISE SHAPES WITH MICRO-SCALE ELEMENTS AND NANO-SIZED CHANNELS

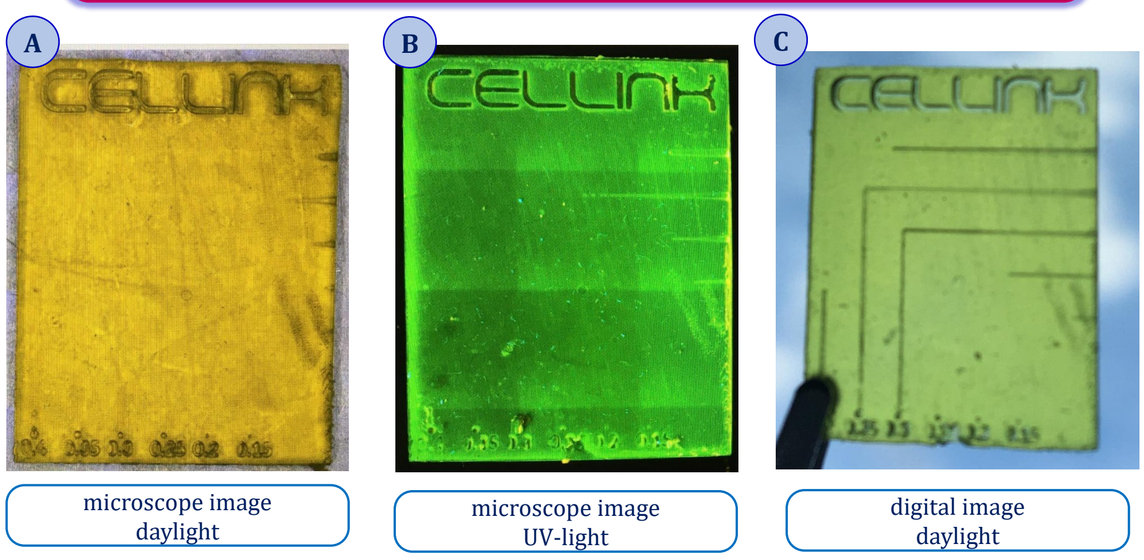

Fig. 3. Photographs of a printout obtained with the use of developed photoinitiators, obtained from a resin composed of PEGDA 700 monomer (70%), PBS (20%) and a novel initiator P3A (0.1%). The 3D material contains internal scale-nanometer channels..

HIGHLIGHTS OF THE INVENTION

- ✓ photoinitiators are well soluble in water, which enables their implementation in biomedical applications where a safe solvent such as water is used;
- ✓ photoinitiators have suitable absorption characteristics allowing their effective use in processes using a safe range of light (visible light, such as Vis-LEDs);
- ✓ these photoinitiators are characterized by high efficiency, providing a fast process of radical photopolymerization and high conversion rates of reacting monomers;
- ✓ these photoinitiators are well suited for use in additive technologies, more specifically in 3D-VAT printing to obtain hydrogel material;
- ✓ the obtained hydrogel materials are characterized by high optical resolution, even for micrometer-sized elements,
- ✓ with the use of novel photoinitiators, hydrogel materials can be obtained for various biomedical applications, including the manufacture of skafolds for 3D cell culture.

ACKNOWLEDGMENT

National Science Centre project PRELUDIUM 19 Grant No. UMO-2020/37/N/ST5/03161

Foundation for Polish Science (Warsaw, Poland) , project START, Grant No. START 087.2022