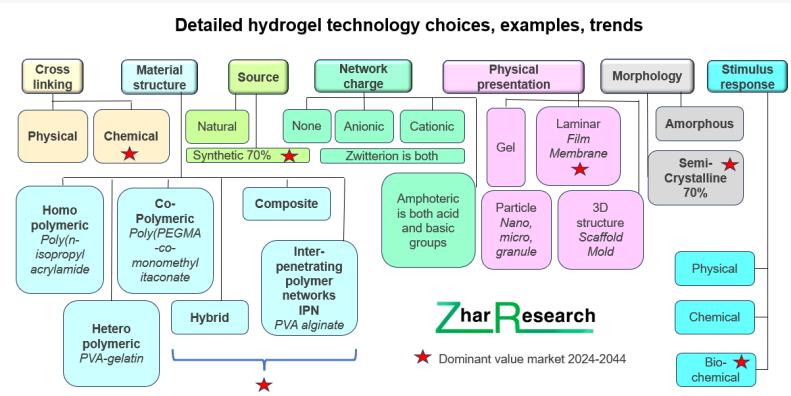
Hydrogels Can Change the Future of Healthcare

LONDON, ENGLAND, UNITED KINGDOM, August 22, 2023 /EINPresswire.com/ -- Hydrogels have graduated from the world of pampers, cooling cosmetics, contact lenses and gummy bears to injectables for drug delivery and other more-sophisticated capabilities. Properties significantly driving the hydrogel market include moisture supply, viscoelastic, lubricious, self-healing, biocompatible and permeable characteristics. In hydrogels the porous permeable solid is a water-insoluble three-dimensional network of natural or synthetic polymers able to trap water or biological fluids to an extent determined by molecular design. Hydrogels are highly cross-linked, three-dimensionally, and the reversible bonds can be “chemical” or “physical”, both resulting in formulations that are usually non-toxic though some have toxic precursors and/or breakdown products that researchers strive to avoid in future.



Detailed hydrogel technology sources, examples and trends. Source Zhar Research report, “Hydrogels: Future Technologies and Markets 2024-2044”.

2023 has revealed a flood of scientific research into medical hydrogels that is nothing short of heroic. They promise to assist the blind to see and the paralysed to walk, for instance.

Such progress is assessed in the new Zhar Research report, “Hydrogels: Future Technologies and Markets 2024-2044” which focuses exclusively on what comes next. Dr Peter Harrop, CEO of Zhar Research says, “These new applications, often involving new hydrogels and their composites, will power the hydrogel market to over $75 billion in 2044. About 70% of the hydrogel value market is healthcare in the broad sense of medical, veterinary, fitness and wellness and both this sector and others have much growth ahead. The medical sector will show the most remarkable advances, in later years even including Engineered Living Materials ELM where hydrogels are the favorite scaffolds.”

Most hydrogel research is directed at increasingly-ambitious medical needs but some hydrogel developments are useful in both medical and other sectors, derisking investment. For example,

emerging smart prosthetics options are relevant to soft robotics and most self-healing hydrogels can be widely useful. Many are multifunctional. Emerging hydrogels will benefit such quests as long-life products saving cost, recyclability, safety, reducing environmental contamination, improving sustainability, replacing scarce materials, facilitating smart city independence of food and water and reversing desertification.
Preventing thinning corneas

This year, a paper "Low Energy Blue Pulsed Light-Activated Injectable Materials for Restoring Thinning Corneas" Advanced Functional Materials 19 July 2023, reports that many alternatives to human donor corneas are being developed to meet the global shortage of donated tissues. Here, transparent low-energy photoactivated extracellular materials are revealed for injection to restore stromal thickness. The injectable biomaterials are comprised of short peptides and glycosaminoglycans (chondroitin, hyaluronic acid) that assemble into a hydrogel when pulsed with safely mild doses of blue light. The formulations remain stable while in-position without stimulating inflammation. The ability of the developed materials to stably rebuild and change the curvature of the corneal tissue make these formulations attractive for commercialisation.

Preventing Blindness From Retina Deterioration

Global estimates indicate that by 2040, there will be 288 million people with age-related macular degeneration AMD yet engineered tissue currently lacks requisite capacity to sustain cell viability and functionality. So says the 2023 paper, "Retinal pigment epithelial cells can be cultured on fluocinolone acetonide treated nanofibrous scaffold" Materials & Design Volume 232, August 2023, 112152.

These researchers remind us that loss or damage to the retinal pigment epithelium (RPE) is a feature of many sight-debilitating eye conditions, genetic, age-related and those that are secondary manifestations of systemic diseases. In work that is related to hydrogel chemistry, they have demonstrated that human RPE cell lines can be cultured on ultrathin suspended electrospun nanofiber scaffolds (ENS) composed of hydrophobic polymer polyacrylonitrile (PAN) and a water-soluble aliphatic diamine, without (untreated) or with (treated) fluocinolone acetonide (FA). The cells survived, retaining morphology for up to 150 days with expression of biomarkers critical for maintaining retinal integrity. As they advise, this novel technique for producing culture substrates provides suitable hydrophilicity and a protective environment for prolonged RPE culture and has immense potential for subretinal transplantation. Zhar Research agrees that this is an excellent potential matrix for treating AMD.

The Paralysed Shall Walk

2023 has see continuation of exciting research at Sagol Center for Regenerative Biotechnology. It is engineering functional human spinal cord tissues, from human materials and cells, and implanting them in laboratory models that featured chronic paralysis, successfully restoring walking abilities in 80% of tests. The technology behind the breakthrough uses patient tissue

samples, transforming it into a functioning spinal cord implant via a process that mimics the development of the spinal cord in human embryos. The cells are reprogrammed to become induced pluripotent stem cells iPSCs, the extracellular matrix ECM is processed to become a personalized hydrogel. This fatty tissue employed is called adipose tissue.

First results were published in "Regenerating the injured spinal cord at the chronic phase by Engineered iPSCs-derived 3D neuronal networks". Adv. Sci. doi:10.1002/advs.202105694 (2022).

The researchers declare that their goal for the next few years is to engineer personalized spinal cord implants to repair tissue damaged from injury without the risk of implant rejection. They are preparing for the next stage of the study: clinical trials in human patients. They intend that, within a few years, the engineered tissues will be implanted in paralyzed individuals enabling them to stand up and walk again.
Other radical advances in 2023

Dr Harrop of Zhar Research adds, "We also salute the researchers that, this year, announce hydrogels to ease the serious symptoms of currently-incurable Crohn's disease and others announcing sensorized soft robotic skins made with new hydrogels that have potential medical and other uses. Yet others have announced a more fundamental approach to anti-ageing for our skin by use of hydrogels beyond today's hydrogel moisturisers. Extracellular vesicles could deliver bioactive molecules, such as proteins, lipids, and nucleic acids, to target cells, promoting skin health and rejuvenation. They have newly announced the groundwork that can lead to enhanced skin hydration but also improved skin texture, and potential anti-aging effects. That is just a sample of this year's vibrant research pipeline that we analyse."

Dr Peter Harrop
Zhar Research
+44 7850 258317
email us here
Visit us on social media:
LinkedIn
