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Crosslinked liposome hydrogels

Stanford researchers have developed crosslinked liposome hydrogels that combine stiffness, injectability, self-healing behavior, and tunable drug release. The platform uses liposomes as dynamic structural elements within a polymer hydrogel, allowing the material to flow during injection or extrusion and then rapidly reform afterward. The hydrogels can support 3D mammalian cell culture, present cell-interactive signals, and release therapeutic molecules such as proteins or antibodies. Many hydrogels used for biomedical applications are either soft enough to inject but too weak for tissue-like support, or stiff enough for cell culture and delivery but difficult to push through small needles or catheters. Existing materials may also rely on animal-derived components, restrictive crosslinking conditions, or formulations that are hard to reproduce. This technology could support injectable therapies, controlled drug delivery, 3D bioprinting, and reproducible cell culture materials.

Stage of Development: in vivo studies

Applications

- Injectable and catheter-delivered biomaterials
- 3D bioprinting inks and scaffolds
- Three-dimensional cell culture and organoid models
- Controlled release of therapeutics and biologics
- Cell and drug delivery for tissue repair

Advantages

- Combines high stiffness with shear-thinning injectability
- Self-healing after extrusion through fine needles or catheters
- Tunable stress relaxation across multiple length scales
- Not animal-derived, unlike Matrigel-based matrices

- Modular polymer and lipid chemistry adaptable to many applications

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