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Automated swelling and degradation testing for hydrogels: Advancing precision and reproducibility in polymer research

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Statement: Swelling and degradation tests are critical for evaluating hydrogels in drug delivery applications, ensuring controlled drug release and biocompatibility. Current manual testing methods are labor-intensive and prone to human error, leading to variability in data and reduced reproducibility. These limitations hinder the development and optimization of hydrogel-based treatments for conditions such as cancer, diabetes, and osteoarthritis. The need for automation in hydrogel evaluation is paramount to advancing precision, efficiency, and scalability in laboratory workflows. GolTech has developed an advanced benchtop laboratory instrument designed to automate swelling and degradation testing of hydrogels. This system integrates robotics, gas and liquid control systems, high-precision load cells, and hyper-functional sample chambers to facilitate precise and reproducible measurements. The second-generation prototype includes automated degradation testing, real-time pH and temperature control, and multi-sample processing capabilities. Performance assessments will be conducted using well-characterized hydrogels such as chitosan, alginate, polyvinyl alcohol, poly(lactic-co-glycolic acid), polyethylene glycol, and hyaluronic acid gels, ensuring rigorous validation against traditional manual methodologies. The automated system enables continuous, real-time monitoring of swelling and degradation kinetics, significantly improving data fidelity and reproducibility. By eliminating frequent manual intervention, this device enhances experimental consistency and efficiency. The integration of advanced sensing and computational tools allows for precise environmental modulation and data acquisition, ensuring superior analytical resolution compared to manual testing approaches. GolTech's automated testing platform establishes a new standard for hydrogel evaluation, addressing critical challenges in precision and repeatability. The technology streamlines hydrogel research, accelerating the development of novel drug delivery systems. Future applications include broader adoption in biomaterials research, enabling a systematic approach to evaluating hydrogel performance under physiologically relevant conditions.

Biography

Sinan Gölhan is the Founder & CEO of GolTech, a pioneering startup developing laboratory automation tools for hydrogel testing in drug delivery. He invented GolTech's first prototype during his research on chemotherapeutic hydrogel drug delivery, leveraging expertise in nanobiotechnology, laboratory automation, and precision drug delivery. With research experience at Harvard Medical School and UC San Diego, Sinan specializes in developing innovative solutions that improve the efficiency, accuracy, and reproducibility of scientific workflows. Under his leadership, GolTech has secured NSF and UC San Diego funding, advancing its mission to revolutionize hydrogel testing with automation. His work is supported by multiple patents, and he collaborates with industry leaders and regulatory agencies to drive laboratory innovation. Sinan's interdisciplinary approach is shaping the future of hydrogel research, accelerating new treatments, and improving patient outcomes.

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