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STEM CELLS MASQUERADE AS IMMUNE CELLS FOR THERAPY

A crucial step to success in stem cell therapy is delivery of the stem cells to the target tissue, where they can help treat the injury or disease. But alone, stem cells lack the ability to detect and adhere to target tissue. Now, a team led by Hyunjoon Kong, Steven Zimmerman, and Lawrence Schook presents a new way to target stem cells to endothelial cells, such as those that line blood vessels, in a way that mimics immune cells (DOI: 10.1021/ja400636d).

They begin by synthesizing a molecule known as bioactive hyperbranched polyglycerol (HPG) tethered to a peptide that binds to endothelial cells. They coat the stem cells with bioactive HPG and introduce them to a blood-vessel-mimicking circulation system. They find that the coated cells adhere to endothelial cells at elevated levels.

Coating stem cells with a bioactive molecule is a noninvasive approach to modifying stem cells to guide their delivery to target tissue. The authors envision that HPG can be functionalized with other bioactive molecules to help target stem cells to other types of tissues as well. **Christine Herman, Ph.D.**

THIN SHEETS OF CARBON MAKE FOR GREAT ELECTROLYTES

Fuel cells store and release energy through electrochemical reactions. At the heart of these reactions is an electrolyte that separates the electrodes and mediates ion transport to keep the reaction moving. A marketable fuel cell must include an electrolyte material that is both highly conductive and reliably active under harsh conditions.

Often, polymers doped or saturated with ion conductive materials comprise a fuel cell electrolyte, but Shinya Hayami and colleagues find that thin sheets of graphene oxide may provide a tantalizing alternative (DOI: 10.1021/ja401060q). A graphene oxide nanosheet is a layer of carbon atoms strung together like chicken wire, with tendrils of oxygenated functional groups that extend outward, like blades of grass.

While bulk graphene oxide is a well-known electronic insulator, the researchers find that protons within single and multiple graphene oxide nanosheets move with amazing efficiency along the oxygenated "lawn". This "superionic" proton conductivity is much faster than that of the bulk material. Interestingly, multiple nanosheet layers conduct protons faster than a single layer. Because graphene oxide is highly stable, cheap, and environmentally friendly, nanosheets of this material appear ideal for faster and more affordable fuel cells, sensors, and chemical filters. **Jenny Morber, Ph.D.**

SMALL MOLECULES BOOST ORGANIC PHOTOVOLTAICS

A customized combination of a promising polymer and small molecules may bring organic photovoltaic cells closer to reality. Yongshai Chen and colleagues analyze the performance and advantages of both conventional small-molecule-based (SM-OPV) and polymer-based organic photovoltaics (P-OPV), then design and synthesize a series of small molecules, and conclude that low short-circuit current density was holding back SM-OPV technology. They have now attempted to engineer a better system by combining the advantages of both small molecules and polymers which are able to sustain a high current density without sacrificing other important electrical properties (DOI: 10.1021/ja403318y).

Most photovoltaic cells today are made from silica crystals and similar inorganic materials, but carbon-based cells could be cheaper if researchers can extract a higher efficiency from them. So far the highest-efficiency organic photovoltaic cells convert over 9% of incoming energy into electricity by trapping excited electrons in carbon-based polymers. Yet the polymers vary from batch to batch, making control of the power conversion efficiency they produce difficult. Cells built from small molecules might offer more consistent and precise performance, but their efficiency of around 7% is still below that of polymer-based cells.

The researchers find that efficiency over 8% could be achieved based on these designed small molecules. They claim the small molecules give them finer control over the cell's performance and could help them reach the 10% efficiency needed to make the OPV cells commercially viable. **Lucas Laursen**

LARGE, QUALITY GRAPHENE SHEETS MAY USHER IN NEW DEVICES

Graphene is a single layer of carbon atoms strung together in conjoined hexagons. It is strong, flexible, conductive, and recyclable and would make an ideal material for integrated circuits and other electronic components. But to work in electronics, graphene sheets need to be both large and atomically perfect, and those requirements have been problematic.

Wei Chen, Wenping Hu, and colleagues report that they have found a solution using a cheap industrial chemical called hexabromobenzene (DOI: 10.1021/ja4031825). Hexabromobenzene looks like a hexagaonal ring of carbon with bromine atoms attached at each point. In a low-temperature reaction, the stabilizing bromine atoms pop off to create reactive carbon hexagons that then link together to form graphene. The researchers confirmed the synthesis mechanism and the high quality of the films with in situ scanning tunneling microscopy, X-ray photoelectron spectroscopy, and field-effect transistors built from the synthesized graphene sheets.

This technique eliminates two of the primary obstacles to graphene's use in electronic components and devices. Other applications that could benefit from graphene's tantalizing combination of properties include single molecule gas detection, electrodes and interconnects, solar cells, electronic DNA sequencing, and biofuel production. **Jenny Morber, Ph.D.**

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