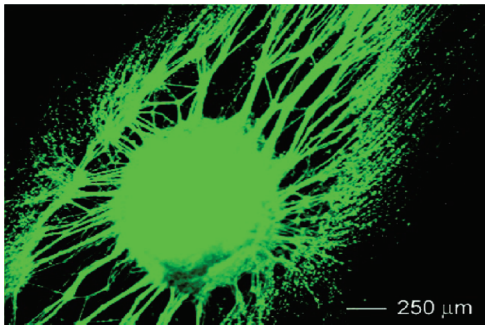
New (Electro)Spin on Directing Neurite Growth

Topographic cues, along with chemical signals, play a strong role in guiding the direction of axon and dendrite outgrowth in neurons. Previous research has extensively investigated the effects of topographic cues on neurite outgrowth using substrates containing microgrooves or microchannels of different depths and widths. These features have typically been generated through nano- or microlithography, though a few studies have used electrospun nanofibers instead. In earlier nanofiber studies, neurite extension was only examined for single-layered scaffolds that contained either aligned or randomly oriented nanofibers.

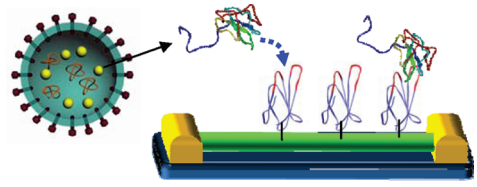


Seeking to increase the complexity of these investigations, Xie *et al.* (p 1151) cultured embryonic chick dorsal root ganglia (DRG) on both single- and double-layered scaffolds of electrospun polymer nanofibers deposited on glass coverslips. The researchers experimented with growing the DRG in conditions of varying topographic intricacy, ranging from single, bare layers of nanofibers in either random or aligned orientations, to those coated with laminin (an extracellular matrix protein), to double layers incorporating both random and aligned nanofibers. The scientists confirmed previous studies suggesting that neurite outgrowth can be guided along the direction of aligned nanofibers. They also found that DRG could produce two different patterns of outgrowth if cultured along the borderline of random and aligned nanofibers, and that they could sense both layers of double-layer scaffolds, adjusting their growth patterns to reflect each one. The authors suggest that these results may help improve understanding of how topographic features guide neurite outgrowth in nature, as well as aid in creating better designs for three-dimensional fiber scaffolds for neuroregenerative applications.

Improving on Antibodies for Nanowire Biosensors

Research has progressed quickly for biosensors based on nanowire or nanotube transistors, moving from concept to proof in less than a decade. These devices utilize a capture agent to bind target biomolecules such as specific proteins and DNA sequences selectively. The bound biomolecules change the electronic properties of the transistor, resulting in a readable signal. Though the capture agent is frequently an antibody, Ishikawa *et al.* (p 1219) hypothesized that a class of proteins known as antibody mimic proteins (AMPs) might offer significant advantages. AMPs can be engineered to have high selectivity and binding affinity. However, unlike antibodies, these low-molecular-weight proteins are stable to a wide range of pH and electrolyte concentrations and producible in large quantities at low cost.

To test the applicability of AMPs in nanowire biosensors, the researchers fabricated devices based on In_2O_3 nanowires and tested their ability to detect

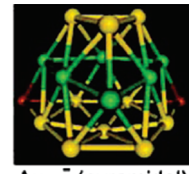


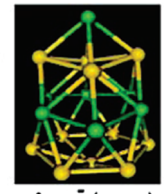
the nucleocapsid (N) protein, a component of the severe acute respiratory syndrome (SARS) virus. The researchers evolved an AMP based on fibronectin, then anchored it to In_2O_3 nanowires incorporated in field effect transistors. When the scientists exposed these devices to solutions containing subnanomolar concentrations of N-protein, conductance rapidly decreased, indicating their ability to detect very small amounts of the target. The response time for these devices was ~10 min, considerably shorter than other diagnostic technologies such as ELISA. On the basis of these results, the authors suggest that AMPs can be successfully employed as capture agents in nanowire and nanotube biosensors, with potential applications ranging from disease diagnosis to homeland security.

Golden Ticket for Catalysis

Though well-known as an inert metal, gold has shown a remarkable range of catalytic activities at the nanometer scale that are not yet well characterized. Consequently, studying the structures and properties of gaseous gold clusters could yield useful information for better understanding the mechanisms behind the catalytic effects of gold nanoparticles. Recent research using a combination of experimental techniques and density functional theory (DFT) calculations has established the structures of gold cluster anions Au_n^- in sizes ranging from $n = 3$ to 20, with Au_{16}^- found to be a cage structure and Au_{20}^- found to be pyramidal. However, how the clusters evolve from a cage to pyramidal structure was unknown.

To investigate, Huang *et al.* (p 1225) performed a series of experiments using photoelectron spectroscopy and DFT to probe the structural transition from Au_{16}^- to Au_{20}^-. Using a helium carrier gas seeded with O_2, the researchers titrated out cage isomers, which reacted with oxygen gas. In similar experiments in which the carrier gas was seeded with Ar, the researchers tagged the pyramidal structures, which formed van der Waals complexes with the noble gas. Their results demonstrate that the transition from cage to pyramid takes place at Au_{18}^-, a size at which the two isomers coexist. These experimental findings have excellent agreement with simulated spectra for Au_{18}^-, adding further support for these results. The authors suggest that additional experimental and computational studies could deepen understanding of the structure of gold nanoclusters and possibly suggest new strategies for designing more efficient catalysts.


Au_{18}^- (pyramidal)


Au_{18}^- (cage)

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