Since January 2020 Elsevier has created a COVID-19 resource centre with free information in English and Mandarin on the novel coronavirus COVID-19. The COVID-19 resource centre is hosted on Elsevier Connect, the company's public news and information website.

How to boost the tin in your GeSn semiconductor alloys

A novel semiconductor alloy can be both light source and mid-infrared sensor according to work published in Materials Today. The germanium-tin alloy can be fabricated as nanowires and with a sufficiently high proportion of tin will display a direct band gap of almost 0.5 electronvolts. Unfortunately, achieving such high ratios of tin to germanium was difficult, until now. [Meng et al., Mater Today (2020); DOI: https://doi.org/10.1016/j.mattod.2020.05.019].

Researchers from Stanford University and Massachusetts Institute of Technology (MIT), point out that relatively high tin concentrations have been achieved using various growth strategies, chemical vapor deposition (CVD) would be the approach of choice for many applications but understanding is quite lacking on how to exploit this approach in this context. As such, the team has carried out a systematic study of CVD approaches to make GeSn semiconductor alloys. They repeated the same synthesis and varied gas precursor partial pressures and shell growth temperatures to see whether they could glean any guiding principles for making these semiconductors and for revealing obstacles that might arise in attempting to make them with high tin incorporation.

Fundamentally, their systematic study has shed light on the specifics of the CVD mechanism for these GeSn alloys. They note hydrogen gas passivation effect whereby a higher ratio of hydrogen partial pressure to tin chloride precursor partial pressure leads to an increase in axial wire growth but a decrease in radial growth. They have also demonstrated that shell growth is mass transport limited, which has implications for optimizing the process. Finally, they found that low shell growth temperature and high shell growth rate lead to a higher proportion of tin present in the final product because of solute trapping due to the suppression of surface diffusion relative to the velocity of the advancing shell surface steps.

Ultimately, they have fabricated nanowires with the optimized composition $Ge/Ge_{0.88}Sn_{0.12}$, which gives rise to minimal residual strain in the shell, high crystalline quality with the requisite large tin incorporation needed for the desired optical properties. The same insights are not only applicable to nanowires made from this semiconductor alloy but apply to etched nanowires, nanosheets, and free-standing two-dimensional crystals.

The nanowires formed in the current work are free of dislocations and exhibit room temperature, single nanowire spectra consistent with direct gap emission from both the shell and the highly tensile-strained core, the team reports.

David Bradley

1369-7021/https://doi.org/10.1016/j.mattod.2020.08.008

Cellular decoys distract coronavirus

Wrapping polymer nanoparticles in membranes from human lung epithelial type II cells and immune cells creates a biomimetic system that can act as a decoy for SARS-CoV-2 which is at the heart of the global Covid-19 pandemic. Laboratory tests discussed in the journal Nano Letters show how the “nanosponges” can reduce viral infectivity by almost 90 percent. The new study builds on more than a decade of the team's biomimetic nanosponge platform.

“Traditionally, drug developers for infectious diseases dive deep on the details of the pathogen in order to find druggable targets,” explains Liangfang Zhang of the University of California San Diego. “Our approach is different. We only need to know what the target cells are.” In other words, the approach works regardless of the nature of the virus and so if it works for SARS-CoV-2 it should work for any future emergent virus that attacks the same cells in the body.

The cloaking with the lung cells makes the nanoparticles mimic the target cells of the virus because all of the target receptors are present in the membrane. The outer membrane of immune system white blood cells, known as macrophages, means that they can also mop up inflammatory cytokine proteins. It is the notorious cytokine storm in response to infection that causes many of the most unpleasant and ultimately lethal effects of Covid-19? The UCSD team sent their nanosponges to colleagues at Boston University for testing. The Boston team used the same live strain of the virus they are also using in their vaccine and drug development programs. They found that at a concentration of 5 milligrams per milliliter, the lung cell membrane-cloaked sponges inhibited 93% of the viral infectivity of SARS-CoV-2. The macrophage-cloaked sponges inhibited 88% of the viral infectivity of SARS-CoV-2. [Zhang et al. Nano Lett. (2020); DOI: https://doi.org/10.1021/acs.nanolett.0c02278]

“From the perspective of an immunologist and virologist, the nanosponge platform was immediately appealing as a potential antiviral because of its ability to work against viruses of any kind,” explains Boston's Anna Honko. “This means that as opposed to a drug or antibody that might very specifically block SARS-CoV-2 infection or replication, these cell membrane nanosponges might function in a more holistic manner in treating a broad spectrum of viral infectious diseases.” This also means that as the current coronavirus mutates, the same therapy should carry on working, again, it is not targeting the virus itself it is mimicking the target the virus aims at.

The next step is to evaluate the putative therapy in laboratory animals and then move on to human trials.

David Bradley

1369-7021/https://doi.org/10.1016/j.mattod.2020.08.007