Jason R. Cox,
Petroleum Engineer,
Boston Research Center,
Saudi Upstream Technology Company,
United States

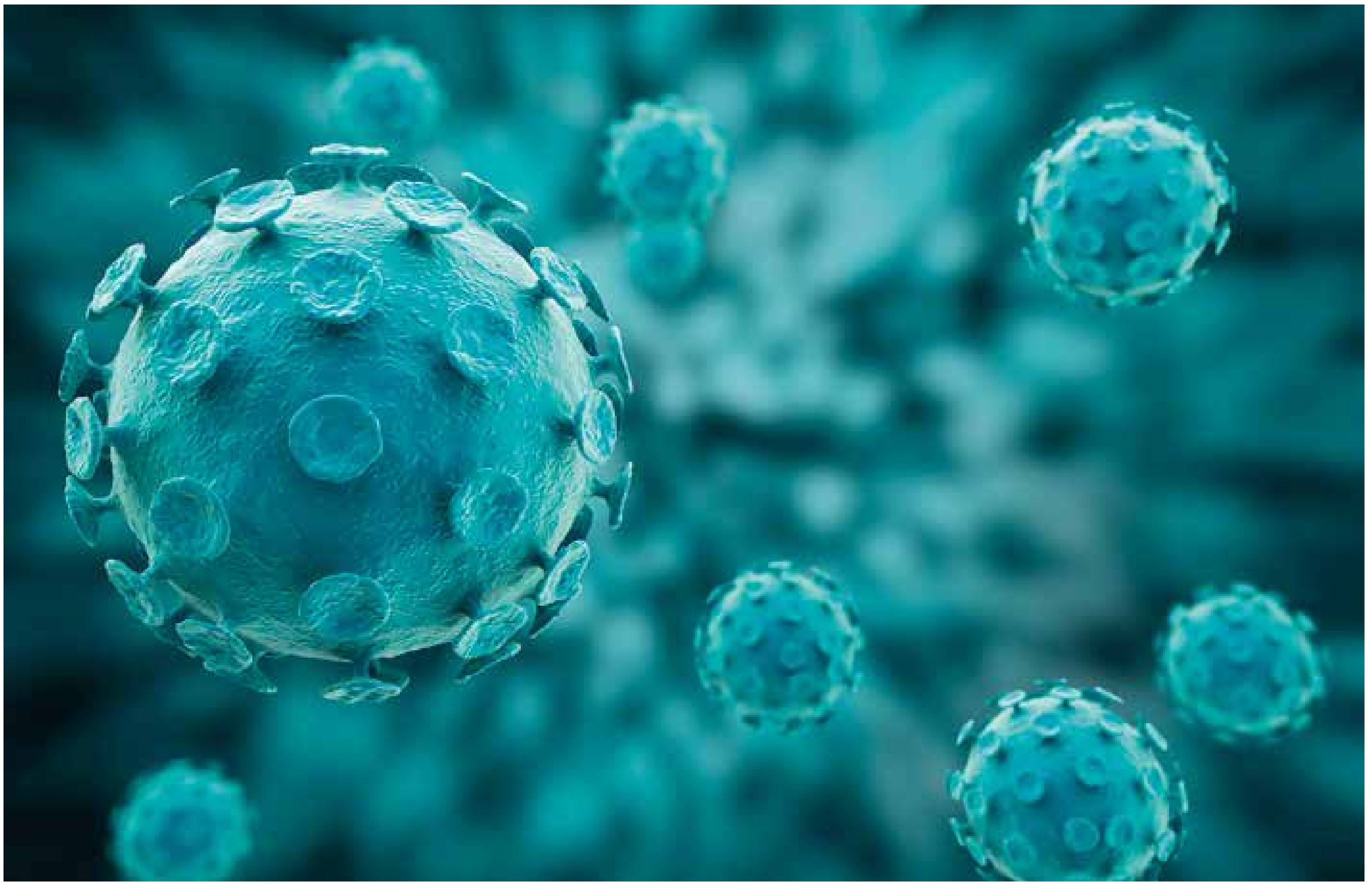
# THE ROLE OF NANOTECHNOLOGY IN OIL AND GAS APPLICATIONS

"Without a doubt, the oil and gas industry should expect a major impact from this branch of technology as resources become more difficult to extract"

We are all familiar with the promises of a not-so-distant future where nanometer-sized robots quickly assemble macroscopic objects or perform targeted delivery of therapeutics to tumour cells in the human body, but the real question is: has nanotech made a real impact on society? We need look no further than the electronics or biomedical fields for an answer to this question. We find nanomaterials embedded in our television displays, as contrast agents in MRI imaging applications and in high-performance transistors.

Where will nanotechnology take our industry going forward? The oil and gas industry has already leveraged nanostructured materials to develop high-strength composites and coatings that can withstand the aggressive conditions that exist in the subsurface. These initial applications only serve to fuel the future development of improved alloys, reinforced elastomers and cables for offshore applications, and smart coatings that adapt to changing conditions in the subsurface. We also expect significant advances in engineered fluids for drilling and production applications. Dendrimers and nanoparticles are already finding utility as loss control additives and rheological modifiers.

Nanotechnology has significantly accelerated the development of new diagnostic and therapeutic tools for biomedicine. Cancer treatments are



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now being delivered to tumours using liposomes, micelles and polymeric nanoparticles – nanomaterials that can be decorated with active targeting modalities to increase the efficacy of treatment by avoiding circulation of the toxic payloads to healthy cells. When we consider these advances in the context of the oilfield we see parallels, namely, the similar objective of delivering chemistries to specific locations in order to maximise the effectiveness of the treatment. This is certainly the case in chemically enhanced oil recovery (CEOR) and acid stimulation applications. The development of smart encapsulation strategies to deliver surfactants and other chemicals deep into the reservoir while mitigating loss to the rock matrix will become invaluable as conventional oil recovery techniques become less effective. We also expect significant advances in nanomaterials being used for reservoir reconnaissance and imaging. Much like the biomedical field, we seek to image deep within difficult matrices that are often obscured by the presence of multiple fluid phases and interfaces. The unique optoelectronic characteristics of nanomaterials offer potential solutions to this challenge, particles that can provide contrast during electromagnetic imaging surveys or the development of acoustic contrast agents.

Finally, the major challenge facing our young generation undoubtedly lies with unconventional tight resources. With recovery rates frequently below 10% and approximately 1/3 of fracture completions unproductive, there is much still to be elucidated. Nanotechnology has spurred the development of high-resolution imaging techniques and instrumentation that are helping researchers to understand the behaviour of shales. Electron microscopy and nanoindentation techniques have allowed scientists to understand how shale structures, and their resulting mechanical properties, evolve as a function of maturity. This information, in turn, is helping us to make informed decisions regarding completions and production.

Without a doubt, the oil and gas industry should expect a major impact from this branch of technology as resources become more difficult to extract.