Role of nanoparticle technology in energy and the environment

Nanoparticle technology is a promising field of interdisciplinary research, which opens up numerous opportunities in various fields in the energy and the environment. Hence, potential uses and benefits of such technology are enormous. Our Nanotechnology Research Group at the University of Calgary has carried out a number of research activities pertaining to the synthesis and direct application of metal-based nanoparticles for enhanced oil upgrading and recovery, wastewater treatment, and H$_2$S and CO$_2$ capture. Methods for the application of nanoparticle technology in heavy oil processing can be conveniently categorized as in-situ and ex-situ application. In the in-situ application, resembles the in-situ upgrading and recovery of heavy oil in reservoir, whereby nanoparticles are directly exposed to real heavy oil feed. In the ex-situ part, resembles the on surface upgrading, nanoparticles are incorporated and dispersed into support and consequently used in a packed-bed process using real heavy oil feed. In both cases, the presence of nanoparticles significantly enhanced the upgrading and recovery of heavy oil. For convective oil recovery enhancement, nanoparticles could decrease the interfacial tension (IFT) and increase the contact area through the reservoir by improving of sweep efficiency. Other mechanisms by which nanoparticles improve the EOR performance include alteration of rock wettability, changes in permeability and reduction in oil viscosity and mobility ratio. In addition, adding nanoparticles to injecting fluid can also prevent formation damage as nanoparticles may serve as inhibitors for asphaltene precipitation. As for wastewater treatment, nanoparticles functionalized with a petroleum vacuum residue (VR) could be used successfully for removing oil from oil–saltwater emulsions at different ranges of pH values. As for H$_2$S and CO$_2$ capture, metal-based nanoparticles could capture sulphur and CO$_2$ and convert them into a chemically inactive mineral within the oil reservoir during the upgrading and/or recovery processes.

In this talk, we will show the recent findings obtained by our group pertaining to the use of in-house prepared metal-based nanoparticles for enhancing oil upgrading and recovery, wastewater remediation and H$_2$S and CO$_2$ capture. We believe our work in synthesis and application of nanoparticles will provide viable alternate clean technologies for enhancing oil recovery, wastewater treatment and CO$_2$ capture.

Biography:

Dr. Nassar is an assistant professor in the Department of Chemical and Petroleum Engineering at the University of Calgary, Alberta Canada. His research has covered various aspects of the processing, simulation and characterization of numerous types of metal-based nanoparticles. His main research interests are in the areas of nanotechnology and its applications in oil and gas industry, such as enhanced heavy oil upgrading and recovery, inhibition of asphaltene formation damage, asphaltene gasification, oil spill remediation, produced and wastewater treatment, as well as air pollution control and polymeric nanocomposites. Dr. Nassar has trained around 25 graduate students and researchers. He published over 60 peer-reviewed publications and made over 50 technical presentations. He co-edited one book and obtained one United States patent. In addition to his excellent research activities, Dr. Nassar has outstanding teaching records as he is an expert in chemical, environmental and oil & gas engineering education, especially in process development and economy, separation processes, process design, effluent treatment processes, and natural gas processing technologies. Dr. Nassar has taught more than twenty-five(25) different courses; at the graduate and undergraduate levels. In addition, Dr. Nassar has instructed and developed a number of workshops and short courses for new engineering graduates, technologists and professionals with different engineering background. Dr. Nassar is acting as the expert reviewer of several grant proposals and prestigious peer reviewed professional journals with high impact factor in the field of environment and energy; including Energy & Fuels, Industrial & Engineering Chemistry Research, Journal of Colloid and Interface Science, Nanotechnology, Science of the Total Environment, Fuel Processing Technology, etc. Dr. Nassar is a professional member of APEGA, and he strongly believes that the health of our environment and the development of our technology go hand-in-hand.