Influence of Colloidal Interaction in Formation and Properties of Organic-Inorganic Nanocomposites

Saeed M. Alhassan

Assistant Professor
Department of Chemical Engineering
The Petroleum Institute
Abu Dhabi, United Arab Emirates

Colloidal interactions are important in understanding and controlling the stability of colloids since these systems are usually far from thermodynamic equilibrium. Colloidal interactions in liquid based colloids are either attractive or repulsive. Derjaguin and Landau, Verwey and Overbeek theory (DLVO) of colloidal stability assumes that the total potential interaction is the sum of attractive and repulsive forces. This additivity assumption does not hold for all colloidal systems, especially for colloids stabilized or flocculated by the presence of polymer in solution. However, the qualitative success of this theory is used to explain the observed phenomena herein. In the first part of the presentation, the effect of electrolyte and polymer addition on formation and mechanical properties of clay aerogels is explored. Incoherent aerogels were formed in samples with 1:5 polymer:clay loading and low electrolyte concentration but all other loadings, coherent aerogels were produced. Aerogels' mechanical properties scale exponentially with relative and bulk density with high exponent values. The high exponent values are attributed to the aerogel layered structure, anisotropy and enhanced exfoliation with polymer addition.

In the second part of the presentation, a new method for exfoliation of graphene in water using turbulent mixing at ambient conditions is presented. In this method, turbulent mixing was used as a mean to overcome the van der Waals forces between graphene layers in graphite while lapontie was used to arrest exfoliated graphene from aggregation. This method can exfoliate graphite down to bilayer as evident from Raman spectra, transmission electron microscopy (TEM) and x-ray diffraction. The produced laponite colloidal Wigner glass is a suitable medium for studying, not only graphene, but also other nanoparticles and biological macromolecules.

Saeed M. Alhassan Bio

After finishing high school from Sheikh Khalifa Bin Zayed School in Abu Dhabi, Saeed Alhassan was granted a scholarship from Abu Dhabi National Oil Company (ADNOC, United Arab Emirates) to continue his studies in Chemical Engineering in the US in 1998. In 2003, he was awarded a bachelor degree in chemical engineering with minor in computer science from Vanderbilt University. In 2004, he was granted a second scholarship from ADNOC to pursue graduate studies. He joined the department of chemical engineering at Colorado School of Mines, where he graduated with master degree in 2006. Then, he joined the department of chemical engineering at Case Western Reserve University, where he worked under the supervision of Prof. Syed Qutudbuddin (Chemical Engineering) and Prof. David Schiraldi (Macromolecular Science and Engineering). He completed his PhD in May, 2011 before joining the department of chemical engineering at the Petroleum Institute in July.

Saeed Alhassan's research focuses on colloids, polymers and surface sciences with emphasis on nanocomposites and processing of nanoparticles. He is two times recipient of Sheikh Rashid Award for Scientific Achievement (2008, 2012) and the first-runner up for the Bayer Fellowship for excellence in graduate studies from the department of Macromolecular Science and Engineering at Case Western Reserve University (2011).