Rice University
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Presents

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Investigation of asphaltenes interfacial behavior at CCNY

Slow gelation of asphaltenes covered interfaces is persistently called to explain crude oil emulsion stability, even if the latter can be obtained after short mixing times. To resolve this inconsistency (and some others), asphaltenes adsorption has been reinvesitagated from scratch. Asphaltenes behave as surfactants insofar they follow an equation of state which can be approximated by a Langmuir model. The associated molecular area corresponds to the average asphaltenes aromatic core parallel to the water surface, in line with previously published Sum Frequency Generation spectroscopy experiments and with our most recent DFTB simulations. The Langmuir adsorption model is however a gross approximation insofar it assumes surfactants to be smaller than adsorption sites (here water molecules). This can be improved with a Lattice Gas model of hexagons covering 4 triangular adsorption sites (a choice dictated the size and shape of asphaltenes aromatic cores). This model not only matches the experimental equation of state but also predicts a fluid to solid transition at the very surface pressure value for which a contracted pendant droplet looses its Laplacian shape. Around phase transition the lattice gas also exhibits some dynamic frustration that would explain the observed Soft Glass (shear) rheology features of asphaltenes laden interfaces. In terms of adsorption dynamics, the coupling of the Langmuir model with a distribution in adsorption coefficient enables matching quantitatively both dynamic interfacial tension and dilational rheology measurements with diffusional models. The slow evolution of interfacial properties between water and asphaltenes solution appears to be governed by the presence of a tiny subfraction of extreme surface activity. Finally the reported onset of emulsion stability at a critical mass coverage can be interpreted in terms of jamming of the interface upon partial coalescence, which would resolve the discrepancy between fast emulsion stabilization and slow evolution of interfacial properties in quiescent experimental setups.

About the Speaker

Vincent Pauchard received a PhD in Materials Science from Ecole Centrale de Lyon (France) in 2001. He then joined the French Institute of Petroleum (IFP) where he worked on flow properties of natural gas hydrates slurries. After five years he joined the Research and Development Center of the world's largest oil company, Saudi Aramco (Saudi Arabia). During 3 years his research was focused on crude/oil water separation and emulsion stability. This industrial experience was later useful to lead the Separation project within the Flow Assurance Center of Innovation (FACE an oil and gas based joint industrial project in Norway). At this occasion, a partnership on asphaltenes adsorption was developed with the City College of New York, which Vincent Pauchard joined in 2014 as an Associate Professor. Since then his interest broadened from asphaltenes to generic interfacial science topics (Lattice Gas and Molecular Dynamic simulations of interfaces, mixture models for dynamic interfacial tension and dilatational rheology, jamming etc.)

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