Environmental Research

Qatar Foundation Annual Research Forum 2011

Panelists: Paul Alivisatos (Lawrence Berkeley National Laboratory), SA Sherif (University of Florida), John Spengler (Harvard University), Adel Sharif (University of Surrey)Presented by The Qatar Foundation
Reported by Erica Gies | Posted February 14, 2012

Overview

The Qatar Foundation Annual Research Forum convened for the second time from November 20 – 22, 2011, in Doha, to discuss progress and challenges in transforming Qatar from a resource-based to a knowledge-based economy and in creating a more sustainable future. The Foundation recruited eminent scientists and leaders from Qatar and around the world to share their insights on how to build a robust R&D infrastructure, encourage regional and worldwide collaborations, and foster entrepreneurship in Qatar. One day of the forum was devoted to a series of research presentations in five areas: energy, environmental, biomedical, computing, and arts and humanities research.

This eBriefing looks at the research presented in the environment track, which included presentations on soil science, advances in chemical processes and products, CO_2 management, and environmental monitoring. A panel of distinguished experts in environmental research challenged the presenters to consider new ways of thinking about their experimental designs and their results.

Advances in Chemistry

Speakers:
Robert Tuba, Texas A&M University at Qatar
Mariam Al-Maadeed, Qatar University
Mohammed Al-Jubouri, Texas A&M University at Qatar

Highlights

- A new liquid-liquid biphasic reaction system makes catalysts more effective.
- Adding locally available, environmentally benign reinforcements to recycled polymers not only strengthens them but also reduces their greenhouse gas footprints.
- New software can help improve the effectiveness of acid stimulation in oil and gas wells.

Toward environmentally benign chemistry

Chemicals are among the building blocks of our modern industrial society, but they come with a heavy price for human health and the environment. Two presentations looked at ways to lighten the impact.

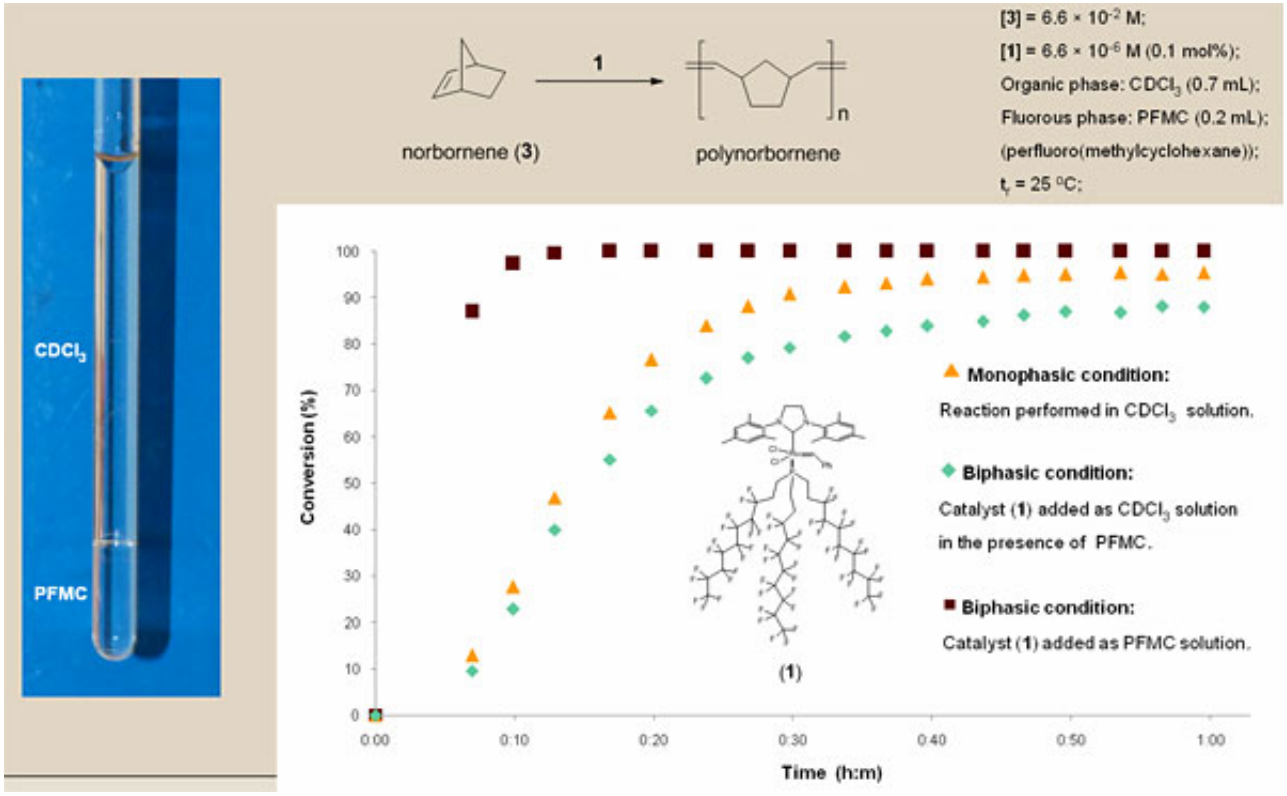
“Green chemistry” aims to develop less hazardous and more energy-efficient chemical products and processes. In that spirit, **Robert Tuba** and his coworkers at Texas A&M University

in College Station, TX, and Texas A&M University at Qatar in Doha, are working to develop a liquid-liquid biphasic reaction system to make catalyst systems more effective. If it works, reactions requiring high temperature and pressure could be conducted more efficiently in moderate reaction conditions such as room temperature and atmospheric pressure, Tuba explained.

Because it is industrially relevant and extensively studied, Tuba and his colleagues have focused their efforts on a ringopening metathesis polymerization (ROMP) reaction that turns the cyclic olefin norbornene (and its derivatives) into a plastic. The catalytic process opens the organic rings of the monomers and links them together to form polynorbornene.

In many catalytic processes, a ligand must dissociate before the catalytic cycle can begin. The reassociation often slows the rate at which that happens. Tuba thought that if the dissociated ligand could be separated from the active species, then he could achieve faster reactions. His two-phase system seeks to prevent such reversal by separating the product of the reaction, dissociated phosphine, from the running reaction. The catalytic process takes place in the organic solvent phase, whereas the fluorophilic, synthetically modified phosphine slips into the fluorous solvent phase and is thereby whisked away from the possible reverse reaction.

Testing the two-phase reaction with chlorinated solvents (CH2Cl2 and CDCl3) as the organic solvent and perfluoro(methylcyclohexane) [PFMC] as the fluorous solvent phase, the team documented accelerations in the biphasic process when compared with reactions in chlorinated solvents using a monophasic process. The biphasic system with PFMC showed a dramatic acceleration when the catalyst was added to the reaction mixture as PFMC solution.



A liquid-liquid biphasic reaction system. (Image courtesy of Robert Tuba)

Now that they have proven the principle, Tuba and his colleagues are working to demonstrate biphasic ROMP polymerization with more environmentally benign solvent systems—for example, by substituting chlorinated organic solvents for toluene and using hydrophilic phosphine ligand and water in place of fluorophilic ligand and fluorinated solvents. The study was recently published in ACS Catalysis.