

The Catalysis Club of Philadelphia

(In Person) Thursday, **Oct 17th, 2024**

Brandywine Plaza Hotel

630 Naamans Road, Claymont, DE 19703

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Novel Rare Earth Technology in Fluid Catalytic Cracking

Speaker: Dr. Yuying Shu

Catalysis Technologies, W.R. Grace & Co., Columbia MD

Student Speaker: TBA

Meeting Agenda:

Social Hour 5:30 PM

Dinner 6:30 PM

Meeting 7:30 PM

Meeting Registration:

Members: **\$45.00**

Non-Members: **\$55.00**

Stud. & Retired Members: **\$35.00**

Please register online for this In-person meeting by **Thursday, October 10th** at [CCP website](#).

Meal Selection (Included):

Please make one selection for your dinner (included in registration) when you sign-up for the meeting from the following options:

1. Sliced Roast Sirloin. Dessert: Cheesecake.

2. Herb Chicken. Dessert: Cheesecake.

3. Seared Salmon. Dessert: Cheesecake.

4. Cavatappi Pasta (vegan). Dessert: fruit cup.

Salad comes with any option: Caesar Salad

Membership Registration:

Membership dues for CCP 2023-24 meeting season will be \$25 (\$5 for the local chapter and \$20 for the national club). Dues for students, post-docs and retirees will be \$10 (\$5 for the local club and \$5 for the national club). Please sign-up membership ([Link](#)) for more benefits on meeting registrations and networking events!

Please contact our Treasurer Steve Hardwick (sjh.wilm.de@gmail.com) or Chair Zhuonan (Nick) Song (zsong@wlgore.com) or Program Chair Brandon Bukowski (bbukows1@jhu.edu) if you need any assistance.

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Dr. Yuying Shu

Novel Rare Earth Technology in Fluid Catalytic Cracking

Catalysts Technologies, W. R. Grace & Co., Columbia MD

In this lecture, Dr. Shu will cover two main topics.

1) Novel rare earth technology in fluid catalytic cracking (FCC)

The USY zeolite in fluid catalytic cracking catalyst is commonly stabilized by ion-exchange with rare earth (RE) cations. The RE-exchange provides hydrothermal stability, resulting in higher surface area retention, less dealumination of the zeolite, and greater preservation of acid sites. Though La and Ce are commonly used in FCC catalysts, we have observed that the stability of REUSY catalysts improves as the ionic radius of the RE cation decreases. In our study, we compare the activity and selectivity of REUSY catalysts, stabilized with light (La) and heavy (Ho, Er, and Yb) rare earth cations—the latter having a smaller ionic radius, due to the well-known phenomenon of lanthanide contraction. The experimental data shows that when lanthanide elements having a smaller ionic radius are used to make the REUSY catalyst, a significant improvement in catalytic activity is achieved. The data also shows that yttrium is even more effective than the heavier lanthanides in stabilizing Y-zeolite. Under a variety of deactivation conditions, yttrium stabilized USY catalysts show higher cracking activity and higher gasoline selectivity than similar catalysts formulated with lanthanum. The results may be explained by the greater Brønsted acidity and hydrocarbon adsorption capacity of the yttrium-stabilized catalysts. Based on this novel rare earth technology (GSI-Grace Stable Activity Improvement), Grace has commercialized Alcyon[®], Alcyon[®]M, Impact[®]-Prime, ResidUltra[™]-Prime, and Fusion[®]-Prime catalyst technologies.

2) Novel catalytic approach towards higher C4 olefins in FCC units

Many refiners in North America have an economic incentive to produce more butylene within the FCC product streams for alkylation unit to increase the octane value of the gasoline. In this section, we will discuss the reaction networks involved in acid-catalyzed light olefins formation, the variables that determine gasoline octane, and the ways by which Grace can exploit such pathways using novel catalytic solutions that increase butylene yield and octane value. In recent years, Grace has commercialized several ACHIEVE[®]400 catalyst families to increase butylene yield. ACHIEVE[®]400 incorporates isomerization activity within the catalyst particle by using two different types of zeolites – a traditional Y zeolite and a specially tuned ZSM-5 zeolite. Incorporation of isomerization activity into the particle itself results in a more desirable yield pattern than the use

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of a traditional ZSM-5 additive. Third generation ACHIEVE® 400 Prime is formulated with Grace GSI proprietary zeolite stabilization technology, to further limit undesired H-transfer reactions.

Speaker Bio:

Dr. Yuying Shu is a Senior Principal Scientist at W. R. Grace, located at Columbia in Maryland. Before joining Grace, she had been an Associate Professor and group leader at Dalian Institute of Chemical Physics (2005-2006), a Visiting Scientist at Chemical Engineering Department of University of Delaware (2004-2005), a Research Associate at Chemical Engineering Department of Virginia Tech (2002-2004), a COE (Center of Excellence) Research Fellow and a NEDO Post-doctoral Researcher at Catalysis Research Center of Hokkaido University Japan (2000-2002). She received her Ph.D. in 2000 at Dalian Institute of Chemical Physics, Chinese Academy of Sciences. Her major research interest is the development of new catalysts and new chemical reactions.

Dr. Shu has worked in developing FCC catalysts and additives for many years and is an expert in this field. She has filed 30 patents application from her discovery. She has published over 70 peer-reviewed journal articles and has given many conferences and invited lectures. She has received many awards including 2020 "GATE" (the Grace Award for Technical Excellence, Grace's most prestigious scientific award), 2018-2020 "Premier Awards" (Grace's most prestigious company-wide recognition of performance excellence), "Top Innovator of The Year for 2010 in Maryland". She has made many significant contributions to Grace Catalysts Technologies and successfully led the efforts to the discovery of ten commercial catalyst platforms.

