UC RIVERSIDE | UNIVERSITY OF CALIFORNIA | Materials Science and Engineering

WINTER 2020 COLLOQUIUM SPEAKER

The Carbon Age: Prospects for reducing global carbon dioxide emissions via innovations in the materials science of fossil fuels

The increase in renewable energy supply is laudable, but unfortunately even in optimistic scenarios will likely make little difference in carbon dioxide emissions. In the US, for instance, electricity accounts for a little over 38% of energy usage. The rest is associated with transportation, industry, and residential energy (heating). So even with 100% renewable electricity (relative to now), over 60% of our energy still needs to be generated by fossil fuels. Of the mix of fossil fuels we use, natural gas has been growing rapidly, significantly displacing coal. The current use-model for natural gas is simply to burn it for heat. We have been exploring a different scientific and economic concept for the use of natural gas. The proposition is that natural gas – primarily methane – can be chemically decomposed into solid carbon and hydrogen with no carbon dioxide produced at all. The hydrogen can be burned as fuel instead of natural gas, producing only water and heat, and the carbon sold for other uses. Solid carbon is quite valuable, and with the right processing (e.g. turn carbon into lightweight structural composites), this approach is much more profitable than just burning natural gas. And there would be no CO2 emissions. The key question – how do you decompose natural gas cleanly and economically? We've developed new chemistry that does just this, without any catalysts, under favorable operating conditions, and "self-powerable" by a fraction of the hydrogen produced. We have embarked on an ambitious project to take our results from the lab scale to the pilot plant scale in a rapid 3-year timeframe. And in answer to the follow-on question – how do you up-value the carbon? – we have been developing novel metallurgical-based approaches to this important problem. Our current results and analysis give us cause for great optimism, suggesting that we can make our environmental and economic vision a reality.

JANUARY 22, 2020 | WINSTON CHUNG HALL 205/206 | 1 PM - 2 PM

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Jonah Erlebacher is Professor and Chair of the Department of Materials Science and Engineering. After receiving a B.S. from Yale in Physics and History of Art, he pursued a PhD in Applied Physics from Harvard, graduating in 1999. He joined the faculty of JHU in 2000 and became Chair in 2014. His work is broad, ranging from metallurgical processing to fuel cell electrocatalysis, to clean energy production.

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