[CHBE] SUPERCRITICAL WATER TECHNOLOGY
FOR UPGRADING MODEL COMPOUNDS AND
HEAVY OILS

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Upgrading heavy oils to produce transportation fuels and chemical feedstocks provides an opportunity for development of innovative new technologies. Supercritical water promoted upgrading (SCWU) has potential to reduce the sulfur content and increase the fuel and chemical content of heavy oil that reduces coke formation and hydrogen requirements compared to traditional refinery technologies. As a new technology, SCWU faces many technological challenges that are exacerbated by knowledge gaps in fundamental understanding. In particular, reaction pathways and rates, thermodynamic phase behavior, and catalyst selection must all be understood for design of processes based on SCWU. This talk will describe our progress in these areas, which have been undertaken in partnership with MIT and with the support of SAUDI ARAMCO. This work has shown that homogeneous reaction in SCWU follows radical pathways, with scission of carbon-sulfur bonds playing a key role. Moreover, we have shown that water participates in the decomposition of sulfide carbon-sulfur bonds directly as a reactant and as a solvent via hydrogen bonding. Catalysts can be selected to further reduce sulfur content. For production of fuels and chemical feeds, SCWU of vacuum residue at 450 °C and 90 min of reaction time in a batch reactor increases the diesel content from 9.9% to 25% and gasoline content from