Adsorbent materials for desulfurization processes under supercritical water conditions

Florentina Maxim, LBK/ENE, Paul Scherrer Institut, 5232 Villigen PSI, Switzerland; *Permanent address*: *"Ilie Murgulescu" Institute of Physical Chemistry, 060021 Bucharest, Romania*

Konstantinos Karalis, LSM/NES, Paul Scherrer Institut, 5232 Villigen PSI, Switzerland

Bojan Niceno, LSM/NES, Paul Scherrer Institut, 5232 Villigen PSI, Switzerland

Christian Ludwig, LBK/ENE, Paul Scherrer Institut, 5232 Villigen PSI, Switzerland

Abstract

Statement of the Problem: It is recognized the great technological potential of the catalytic supercritical water (SCW) gasification of biomass for biofuel production [1, 2]. However, an important issue related to the poisoning of the catalyst by sulfur (S) compounds remaining in the SCW phase [3] is still to be solved. To design efficient S adsorbents at SCW conditions is a challenge since the sorbent material, which is sought as metal oxide (Me_xO_y) [3, 4], must be structurally stable, and, in the same time, to be able to capture S from both inorganic and organic sources under SCW conditions. The purpose of this work is to design and obtain supported nano Me_xO_y adsorbent materials for efficient desulfurization in SCW. Our previous results reported on the impact of sorbent geometry on the S adsorption in SCW [5]. *Materials & Methodology*: SCW impregnation of Me_xO_y (ZnO, CuO, Mn_2O_4, Fe_2O_3) on activated carbon was performed in a continuous flow tubular reactor (Figure 1), also used for S sorption experiments. In-situ neutron imaging (NI), molecular dynamics (MD) and computational fluid dynamics (CFD) were the main techniques used to obtain fundamental knowledge on the phenomena taking place when different S species are adsorbed by Me_xO_y in SCW. *Findings*: The NI results, reporting on the S in SCW density profiles and flow patterns through the adsorbent, were used for the validation of models applied in MD and CFD. The SCW desulfurization efficiency of different Me_xO_y was established. *Conclusion & Significance*: The findings of the present study are of great importance when the goal is to mitigate the deactivation of the catalyst by S from the foregoing biomass gasification by SCW. *Acknowledgments*: SNF and PSI-CROSS projects are acknowledged. Iacob and Nicolae (Computer Power SRL, Romania) and Contescu (ORNL, USA) are truly acknowledged for their help.

Image

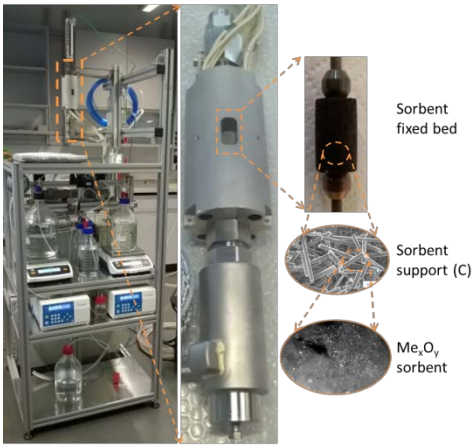
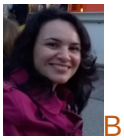


Figure 1 Dedicated experimental setup for desulfurization under SCW conditions

Recent Publications

1. Lachos-Perez, D., et al., (2017) *Applications of subcritical and supercritical water conditions for extraction, hydrolysis, gasification, and carbonization of biomass: a critical review*. Biofuel Research Journal-Brj, 4(2): p. 611-626.
2. Stucki, S., et al., (2009) *Catalytic gasification of algae in supercritical water for biofuel production and carbon capture*. Energy & Environmental Science, 2(5): p. 535-541.
3. Peng, G., C. Ludwig, and F. Vogel, (2017) *Catalytic supercritical water gasification: Interaction of sulfur with ZnO and the ruthenium catalyst*. Applied Catalysis B-Environmental, 202: p. 262-268.
4. Ates, A., et al., (2014) *The role of catalyst in supercritical water desulfurization*. Applied Catalysis B: Environmental,. 147(0): p. 144-155.
5. Maxim, F., et al., (2017) *The impact of sorbent geometry on the sulphur adsorption under supercritical water conditions: a numerical study*. Biomass Conversion and Biorefinery, p. 1-7.



Biography

Florentina Maxim has her expertise in the hydrothermal synthesis and the characterization of nano metal oxides. She received her doctorate in 2010 for work on the morphology control of nanoferroelectric metal oxides work carried out in the group of prof. Paula Vilarinho at University of Aveiro, Portugal. After several research fellowships for Electron Microscopy, she was leading the project for Young Independent Research Team funded by the Romanian national foundation UEFISCDI. Since 2015 she is working as a postdoctoral scientist at Paul Scherrer Institut, Switzerland and her major research activities are in the field of advanced materials for energy harvesting from biomass (algae) by supercritical water processes.

Email: florentina.maxim@psi.ch

Notes/Comments: