



Contribution ID: 16

Type: Oral Presentation

Mesoscale Modelling of Thermal-Chemical processes during Nuclear Fuel Corrosion

Monday, 31 May 2021 15:10 (15 minutes)

Understanding corrosion mechanisms and processes of UO₂ fuel is essential for safe operation of nuclear reactors and storage of spent fuel [1-3]. We develop a 3D physics-based numerical model to simulate the thermal-chemical process during the corrosion of UO₂ fuel pellets. Mass transfer, thermal conduction and solid chemical reactions are coupled in the model. The impact of temperature on uranium speciation during fuel corrosion is investigated. The UO₂ pellets lifetime under corrosion is compared at same temperature but different reactions. The predicted reaction rates are shown to be dependent on the reaction types. The impact of microfractures on fuel pellets corrosion are studied by modelling reactions in fractured pellets. The composition change caused by radiation is also explored. The fuel with UO₂-U₃O₈ mixture is constructed. The results show the mixed fuel presents faster reaction rates in comparison with pure UO₂ samples. The developed model will help quantify the effect of temperature on nuclear fuel dissolution and, help determine the key parameters controlling the physiochemical processes and ultimately inform the nuclear industry.

Time Block Preference

Time Block C (18:00-21:00 CET)

References

- [1]Liu, M., Kang, Q., & Xu, H. Grain-scale study of the grain boundary effect on UO₂ fuel oxidation and fission gas release under reactor conditions. *Chemical Engineering Science*, 229, 116026.
- [2]Liu, M., Kang, Q., & Xu, H. (2020). Modelling uranium dioxide corrosion under repository conditions: A pore-scale study of the chemical and thermal processes. *Corrosion Science*, 108530.
- [3]Liu, M., & Mostaghimi, P. (2018). Reactive transport modelling in dual porosity media. *Chemical Engineering Science*, 190, 436-442.

Acceptance of Terms and Conditions

[Click here to agree](#)

Newsletter

Primary author: LIU, Min

Presenter: LIU, Min

Session Classification: MS17

Track Classification: (MS17) Thermal Processes, Thermal Coupling and Thermal Properties of Porous Media: modeling and experiments at different scales