Program FYSICA 2019
Friday, April 5
Amsterdam Science Park
www.fysica.nl

Parallel Session title: **Power2Fuel**

Abstract: The Paris agreement (April 2016) leaves no doubt that for both energy plants as well as petro-chemistry, carbon dioxide emissions should be completely banned in 2050. This goal represents a huge challenge for both fundamental science and technology, but also for politics in an international context. For Northern Europe, the main sources for electrical energy will be solar and wind energy. These sources are both discontinuous in their supply, but will have to be matched with a continuous demand. Especially for slow time scale variations (seasonal time scale) this cannot be solved using batteries. This leads to the need for the production of carbon based energy-dense chemicals using renewable electrical energy, using atmospheric CO2 on a large scale. To be able to reduce atmospheric CO2 in the nearer future, carbon capture and storage (CCS) is topical. In this Power2Fuel session, the latest developments concerning the above mentioned fields are presented

Convener: Lodewijk Arntzen (HHS)

Speakers (in order of appearance)

Title: **Towards the sustainable production of carbon based chemicals and fuels from renewable resources**

Wilson Smith (TUD)

Abstract: Electrocatalytic CO_2 reduction has the dual-promise of neutralizing carbon emissions in the near future, while providing a long-term pathway to create energy-dense chemicals and fuels from atmospheric CO_2. The field has advanced immensely in recent years, taking significant strides towards commercial realization. While catalyst innovations have played a pivotal role in increasing the product selectivity and activity of both C1 and C2 products, slowing advancements indicate that electrocatalytic performance may be approaching a hard cap. Meanwhile, innovations at the systems level have resulted in the intensification of CO_2 reduction processes to industrially-relevant current densities by using pressurized electrolytes, gas-diffusion electrodes and membrane-electrode assemblies to provide ample CO_2 to the catalyst. The immediate gains in performance metrics offered by operating under excess CO_2 conditions goes beyond a reduction of system losses and high current densities, however, with even simple catalysts outperforming many of their H-cell counterparts. Using recent literature as a guidepost, this talk will focus on some of the underlying reasons for the observed changes in catalytic activity, and proposes that further advances can be made by shifting additional efforts in catalyst discovery and fundamental studies to system-integrated testing platforms.

Title: **CO2 capture from flue gas and the air: a short review**

Hans Geerlings (TUD)

Abstract: CO2 capture from industrial gases like flue gases is a well-established technology that is available for deployment at large scale. Capture of CO2 from the air, which is a key technology in envisaged solar fuel synthesis schemes, has not reached that state of development yet. In this overview, the physics of both families of capture technologies will discussed with the emphasis on differences and similarities. It will be made clear that CO2 capture from the air requires dedicated development effort both at a fundamental and technical development level.

Title: (to follow)

Richard van de Sanden (DIFFER)

Abstract: (to follow)

Title: **Geological storage of CO_2: it's all about the physics**

Suzanne Hangx (UU)

Abstract: In order to curb global CO_2 emissions, carbon capture and storage (CCS) is considered to be one of the technologies able to reduce emissions on a short to medium time scale, with global storage capacities ranging from 100's to 1000's of gigatonnes. Suitable storage locations under consideration are depleted oil/gas reservoirs and deep, saline aquifers. However, injecting CO_2 into the subsurface removes the natural system from its chemical and physical equilibrium. Fluid injection inevitably leads to a (poro)elastic response of the storage reservoir. In addition, high-pressure CO_2 injection will lead to thermal effects and acidification of the reservoir pore fluid. These in turn may impact the hydrological and mechanical behaviour of not just the reservoir, but also the overlying seal formation and any pre-existing faults within the storage complex. To ensure safe, long-term storage is therefore dependent upon maintaining containment integrity, i.e. keeping the stored CO_2 in the subsurface for > 10,000 yrs. Research has extensively focused on understanding this complex interplay between thermal, hydrological, chemical and mechanical processes. This has led to clear implications for site selection and assessing safety, but perhaps this knowledge can also form a basis for understanding future uses of the subsurface, such as energy storage or geothermal energy production.