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Prediction of corrosion of metals making use of multiscale modelling

Terryn, H.(1);

(1) Vrije Universiteit Brussel;

Keynote: In the advanced materials industry, there is a clear trend towards more sustainable concepts, and this is certainly also the case for metals. Nowadays, metals are developed for providing components with a typical lifetime ranging from 10 to 25 years. The lifetime of a metal highly depends on its exposure to the environment inducing ageing processes. In the current state of the art, lifetime and ageing assessment are performed by means of experiments, combining accelerated and field testing. The limitation of the first is that the conditions of the accelerated tests are not representative for the real environmental conditions and that there is no proven relationship between accelerated laboratory tests and field performance data. The limitation of the second is that it takes several years (5 to 10 years). The long term scientific motivation of our research is to build a knowledge and technology platform to enable the prediction of durability behaviour and the estimation of lifetime of (organic coated) metals under long-term environmental ageing and corrosion conditions. This requires advanced research because corrosion of a (organic coated) metal is the result of an intense interplay between several physical phenomena that need to be characterized in real conditions and modelled. Within VUB and TUDelft research we try to focus on both aspects bringing in new advanced combined electrochemical & in situ surface analysis, advanced finite element electrochemical modelling and more recently quantum chemical modelling. At the end of the presentation the recently started Horizon 2020 project VIPCOAT will be introduced. Twelve partners from seven countries have united to make the development and production of corrosion protection technologies more sustainable, economical and faster. The Helmholtz-Zentrum Hereon is coordinating the project. The European Union is funding VIPCOAT (<https://ms.hereon.de/vipcoat/>) within the Horizon 2020 program, specifically for the area of Nanotechnologies, Advanced Materials, Biotechnology, and Advanced Manufacturing and Processing” (NMBP), over four years. The project has been started on May 1st, 2021. The goal of the EU-funded VIPCOAT project is to create an open innovation platform that should assist engineers in developing coating materials and constructing accelerated life test scenarios to assess their durability. Initially, the platform will target the aeronautic industry. However, it will later host interoperable applications, based on standardized ontologies as extensions of the European Materials Modelling Ontology that should enable to transfer methods and insights to other industries. The VIPCOAT platform will open the door to new production concepts with reduced process steps, lower energy consumption and reduced use of natural resources. Supporting modelling, the platform should also promote the development of green, cheap and efficient coatings that inhibit corrosion.