Assessment by the evaluation committee for Yara's Birkeland Prize 2013

Yara's Birkeland Prize for 2013 is awarded to PhD Jonathan Marc Polfus for his thesis Nitrogen in Oxides - Electrical Characterization and Computational Studies of Defect Equilibria and Electronic Structure, for which he was awarded the degree of Philosophiae Doctor at the University of Oslo in 2012. The work was carried out under the supervision of associate Professor Reidar Haugsrud and Professor Truls Nordby.

The statutes of Yara's Birkeland prize say that the work should be in accordance with Birkeland's research philosophy. Birkeland was the person who first elucidated the nature of the Aurora borealis. He is known for his cutting edge and innovative research combining theoretical and empiric data, and probably most known for being an entrepreneur in the Birkeland-Eyde process of fixing nitrogen from the air to nitrogen oxides using a plasma arc, which was then used in industrial fertilizer production. The prize and the award ceremony shall focus on environment and technology, and create interest for interdisciplinary research and development.

Nitrogen and oxygen were also important elements in Jonathan Marc Polfus' work. The work focuses on the solubility of nitrogen in an oxide structure as a function of temperature and atmospheric conditions, which so far has been studied only to a small extent. The substitution by nitrogen gives point defects in an oxide layer and influences the functional properties of the structure. For example will nitrogen from ammonia as fuel dissolve in the anode and the electrolyte in a solid-oxide fuel cell and influence its efficiency. Nitrogen is also shown to change the photo catalytical properties in an oxide layer used in e.g. a water purification system.

Polfus combined the use of computational methods with using data from experimental results to achieve a more complete knowledge of the physiochemical processes when nitrogen is added to an oxide structure. A high number of oxides are examined by calculations for nitrogen defects including MgO, CaO, SrO, Al_2O_3, In_2O_3, Sc_2O_3,Y_2O_3, La_2O_3, TiO_2, SnO_2, ZrO_2, $BaZrO_3$ and $SrZrO_3$. The thesis includes 6 papers published in highly ranked international journals with Polfus as first author. The last paper in the thesis is an excellent review of experimental and theoretical studies on the defect chemistry of nitrogen in oxides.

The results from Polfus' work have high potential in terms of developing more environmentally friendly methods for producing energy, but also for possible applications towards e.g. making more efficient water purification systems and improving corrosion resistance in materials.