REACTOR AND PROCESS DEVELOPMENT FOR PLASMA ASSISTED NITROGEN FIXATION REACTION

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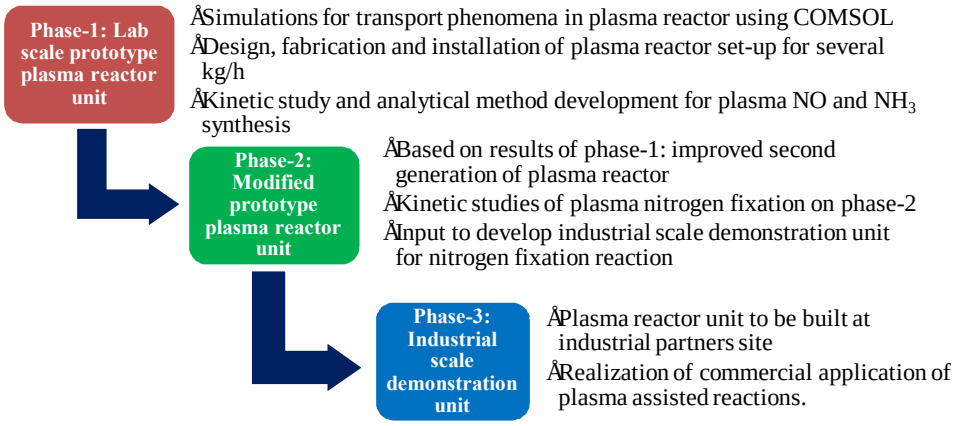
Chemical nitrogen fixation reactions have large industrial importance. Fixed nitrogen is used in many different forms ranging from nitric acid to hydrogen cyanide and used as such for large-scale industrial application (e.g. fertilizer, plastic manufacturing, etc.). The reactions to produce these products are highly endothermic and favoured by high-temperature processing. The most simple and basic route of chemically fixing nitrogen is the direct reaction of nitrogen and oxygen. However, the major challenges to do so are to supply very high dissociation energy for nitrogen (7.4 eV) and rapid quenching of the product mixture to suppress reformation of elements.

The main objective of this project is to develop an energy efficient chemical nitrogen fixation process by using catalyst and assisting reaction by an alternative energy form which is plasma, aiming to achieve a process on industrial scale. Various catalysts will be tested for nitrogen fixation in the form of nitric oxide and ammonia; energy consumption per kg of fixed nitrogen will be measure for all these catalysts. COMSOL multiphysics simulations will be used to understand the plasma reactions and transport phenomena inside plasma reactor by simulating the temperature distribution, electron density and mean electron energy distribution. These results will be used to develop the holistic process design for plasma nitrogen fixation process [1,2]. This project is planned to go through following phases.



[1] Hessel, V., Cravotto, G., Fitzpatrick, P., Patil, B., Lang, J. & Bonrath, W. *Chemical Engineering and Processing: Process Intensification*, doi:10.1016/j.cep.2013.02.002 (2013).
[2] Hessel, V., Anastasopoulou, A., Wang, Q., Kolb, G.A. & Lang, J. *Catalysis Today*, accepted in press.