**Nitrogen Fixation Beyond Ammonia**

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**Home Department**: Department of Chemical Engineering at Imperial College London (South Kensington Campus)

**Funding and Deadline:** To be eligible for support, applicants must be “UK Residents” as defined by the EPSRC. The studentship is for 4 years starting as soon as possible and will provide full coverage of standard tuition fees and an annual tax-free stipend of approximately £20,622. Applicants should hold or expect to obtain a First-Class Honours or a high 2:1 degree at Master’s level (or equivalent) in any relevant chemistry or science subject.Funding is co-funded through [Engineering and Physical Sciences Research Council](https://www.ukri.org/councils/epsrc/) (EPSRC) and [BASF](https://www.basf.com/gb/en.html).

**Project summary**

The Industry Case (I-Case) PhD student will join an interdisciplinary cohort of students working under the umbrella of the IConIC Prosperity Partnership An internship of min. 3 months will be facilitated and sponsored by BASF for the utilization of specific infrastructure and technology transfer.

Ammonia synthesis has been the main industrial nitrogen fixation process for almost a century. Improvements to catalysts involved have become marginal. The carbon footprint of ammonia synthesis is significant and contributes significantly to global CO2 emissions. Significant efforts to make ammonia synthesis more sustainable are underway. Less emphasis has been put on the search for alternative nitrogen activation processes (plasma or electrochemical) and nitrogen containing building blocks to displace ammonia in the nitrogen value chain. From an atom and redox economic point of view the most interesting nitrogen containing activated molecule would be HCN (hydrogen cyanide). Industrially the synthesis of HCN involves the reaction of methane, ammonia and oxygen at very high temperatures over heterogeneous platinum catalysts. Since both, ammonia and HCN synthesis require heterogeneous catalysts, albeit under different conditions, it is conceivable that catalysts and conditions could be found to directly convert hydrocarbons and nitrogen to HCN under industrially relevant conditions.

Key questions to be addressed during the PhD will be:

- Can a catalytic system be designed that facilitates the synthesis of HCN from acetylene and nitrogen directly (most atom economic fixation)? - Can the use of different, industrially accessible carbon sources like methane facilitate an overall attractive process for the synthesis of HCN? - Can we simultaneously activate nitrogen and C-H or C-C bonds under industrially relevant conditions? - Can the conditions under which above activation typically occurs (e.g. Andrussow process >1000 °C) be reduced through workfunction modification achieved via DC application to semiconductor support materials? – there is prior evidence for this in the case of the reverse water gas shift reaction. - Can a catalytic or chemical looping process be designed based on reliable rate data to yield an economically feasible outcome?

To apply, please complete an application form [Application process | Study | Imperial College London](https://www.imperial.ac.uk/study/apply/postgraduate-doctoral/application-process/). Informal enquiries about the post and the application process can be made to Bhavna Patel ([iconic-pp@imperial.ac.uk](mailto:iconic-pp@imperial.ac.uk))